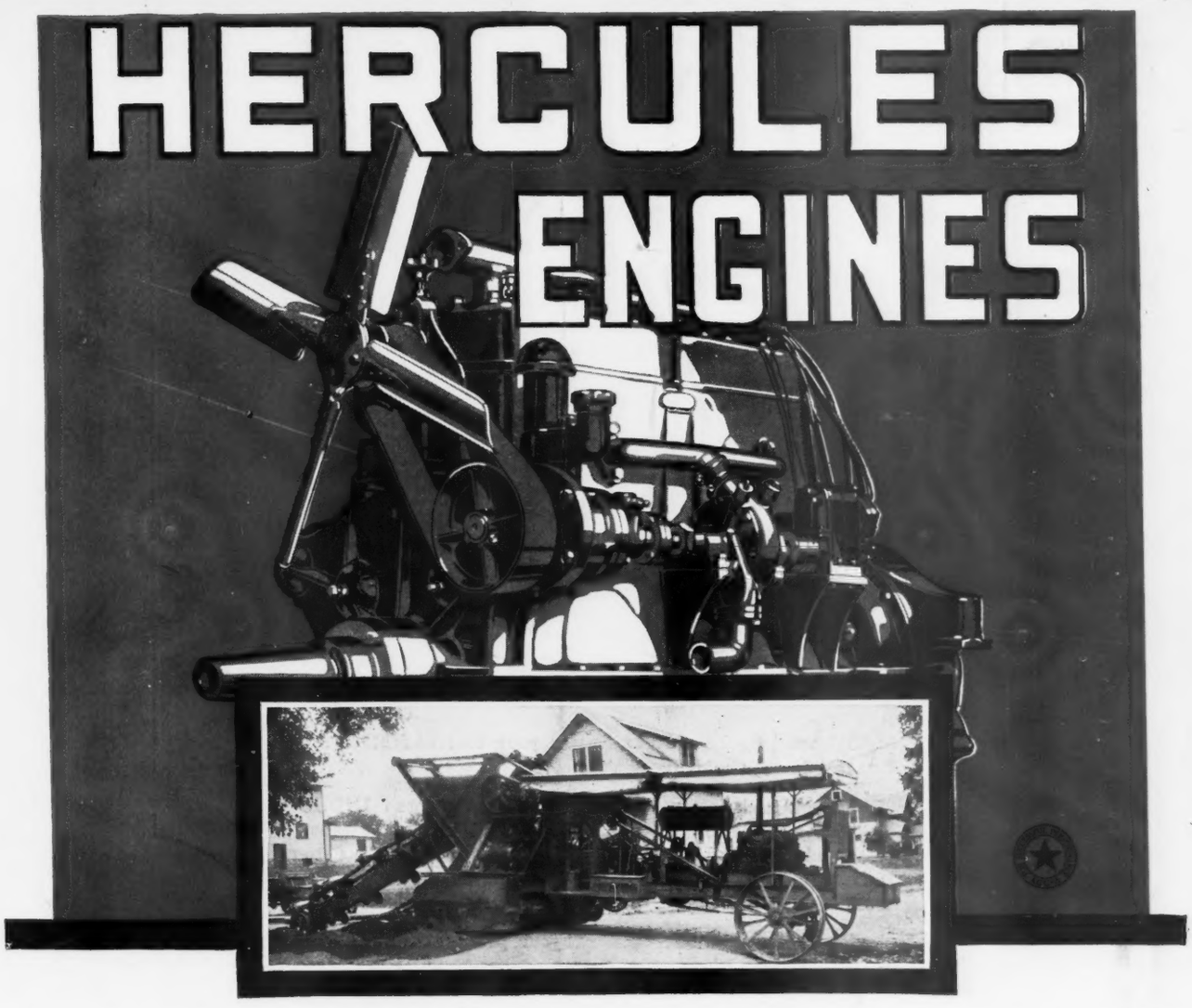
Pit and Quarry

SAND-GRAVEL-STONE
CEMENT-LIME-GYPSUM

HERCULES ENGINES



Under the brutally-constant strain of ditch digging, the power plant must be dependable and constant.

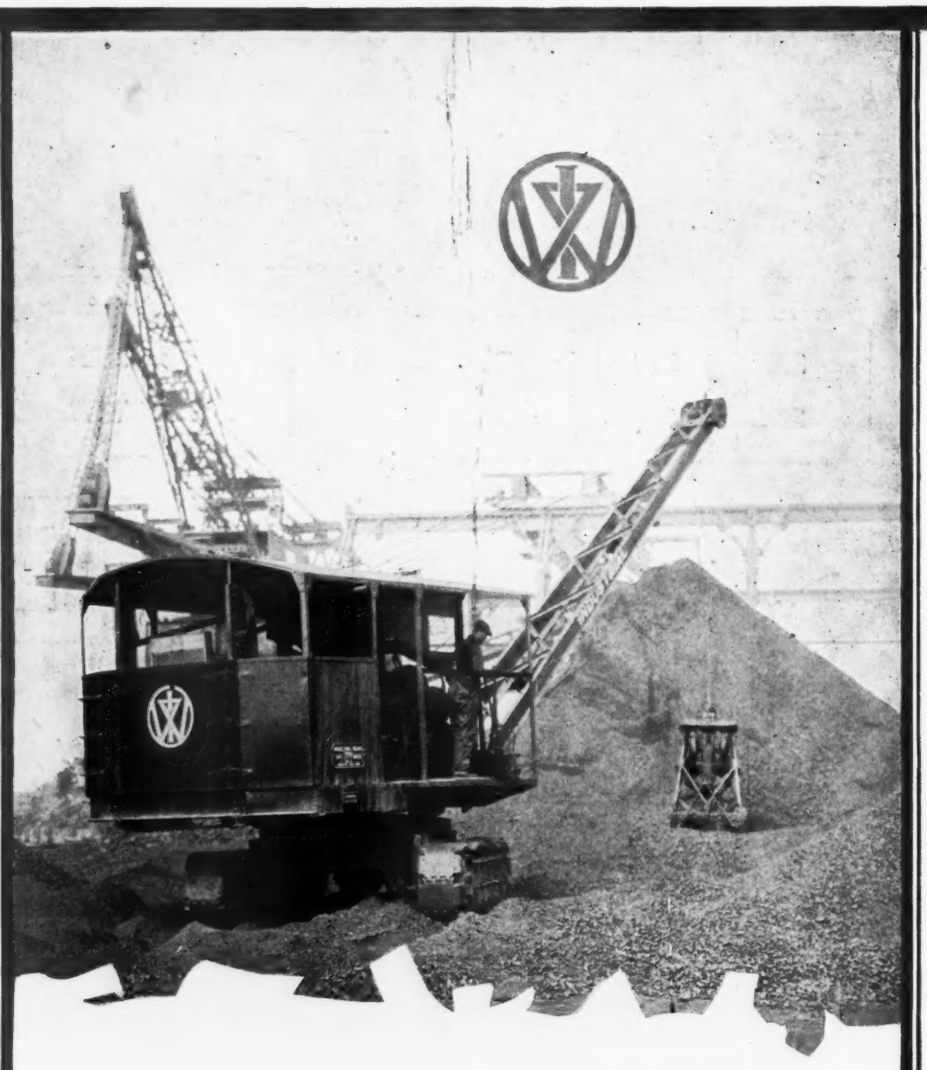
Shocks of varying degrees of severity, imposed without quarter, must at all times be withstood. There can be no hesitation, no faltering!

It is natural, therefore, that the Buckeye Traction Ditcher Company of Findlay, Ohio, has chosen Hercules Engines as the power plant for their Type C Model 200 Trench Excavator.

For Hercules Engines — of greatest simplicity of design — start when the switch is thrown in and stop only when it is thrown out.

HERCULES MOTORS CORPORATION, CANTON, OHIO, U. S. A.

YOU DO DON'T YOU?



YOU want to be able to handle your coal and other materials economically, don't you?

Then you had better investigate the all purpose INDUSTRIAL cost cutting crawlers. They will handle busheling scrap at less than 5c per ton, coal at less than 2c per ton and sand or gravel and similar materials at the astonishing cost of 1.2c per ton.

Reduce your costs and increase your profits. We can help you. Write us today.

Steam—Gasoline—Electric—Diesel

SHOVELS—CRANES—DRAGLINES

INDUSTRIAL WORKS BAY CITY, MICHIGAN

BRANCHES:

Atlanta, Ga. Hurt Bldg. | Chicago, Ill. McCormick Bldg. | Cincinnati, Ohio Dixie Terminal Bldg. | Detroit, Mich. Book Building

New Orleans, Louisiana Whitney Central Bldg. | New York City 50 Church St. | Philadelphia, Pa. Packard Building

Pittsburgh, Pennsylvania Federal Reserve Bldg. | San Francisco, Calif. Monadnock Building | St. Louis, Mo. Railway Exchange

Pit and Quarry

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ONLY THE BARBER-GREENE HAS THE DISC-FEED—*AND FLOATING BOOM*

Walking across rough ground—straight into a pile of gravel.

Sailing Over the Rough Spots
with the Floating Boom

No matter how rough and tough the going is, it can't hurt the Barber-Greene "42" or "25." Both have the patented floating boom that sails over the bumps—without transferring the twists and strains back to the loader itself.

This floating boom is one big reason why Barber-Greenes last so long on even the toughest kind of work—such as loading directly from pit banks and handling frozen materials. And it helps to explain why the average cost of Barber-Greene Loader repairs is so remarkably low.

BARBER-GREENE COMPANY
492 W. PARK AVE. AURORA, ILLINOIS

25 Loaders 42

B Barber-Greene G

Barber-Greene Loaders

Representatives in 50 Cities
DISC FEED LOADERS VERTICAL BOOM DITCHERS
STANDARDIZED PORTABLE AND PERMANENT BELT CONVEYORS
SNOW LOADERS CAR UNLOADERS COAL LOADERS

THIS COUPON shows you how others are handling jobs like yours, through the copy of "Loading Layouts" which it brings you.

Many of the interesting loading jobs which Barber-Greene men ran across last year, in various sections of the country, are represented.

Send for your copy today. It may show the way to cheaper loading.

Send for a copy today—this coupon brings it, without obligation.
BARBER-GREENE COMPANY
492 W. Park Ave., Aurora, Ill.

Name.....
Address .....
City .....
State.....

Pit and Quarry

Vol. 14 CHICAGO, ILL., SEPTEMBER 14, 1927 No. 12

WHAT VALUE ASSOCIATION ADVERTISING

JUST a few years ago sauerkraut as an article of diet was a joke. It could hardly be said that sauerkraut occupied a prominent place in the nourishment of the American people. Indeed, if one liked that cabbage concoction and enjoyed eating it, that one would seldom admit the damning fact, for such admission would either set him up as a target for home-spun wheezes or identify him as a member of the proletariat. Sauerkraut was just a bit too plebian for the American table.

During the past three years that condition, largely mental, has been reversed and today thousands of American families eat, enjoy and thrive on sauerkraut. What is more these same people are not only glad to admit that fact, but given an opportunity will expand on the subject. It appears on the menus of the finest grills, clubs, hotels and restaurants in the country.

This far reaching change did not just happen. It was brought about by advertising. Not ordinary advertising that implored the reader to "eat Guggenslocker's sauerkraut"—but constructive, group advertising, signed and paid for by the association of kraut manufacturers, and which informed the reading public of the body building, palate tickling qualities of that cabbage affair.

Association advertising, and cooperative marketing, are two mediums through which a great deal of money may be wasted—or a gratifying increase in volume may be effected; the result depending entirely upon the basic plan, the method of procedure and the continuity of effort. In the case of the kraut packers, the plan called for an assessment of 50 cents a ton on all cabbage cut into kraut, payable by every member of the Kraut Packers Association. This assessment yielded $50,000 annually, which sum was devoted to advertising. The campaign started in 1922 and with the result that prejudice was transformed into goodwill—consumption increased nearly 20 per cent every year—the largest cabbage crops in history were raised, the truck-farmers afforded a reliable market—and the kraut industry, which formerly, like the mule who could not boast of ancestry and had no hope for posterity, has come into a degree of respect hitherto unknown.

Many other association advertising campaigns and cooperative marketing plans have interesting experiences behind them. Through the Periodical Publisher's Association we learn of the outstanding effects of some of them, such as the American Face Brick Association which increased production 2½ times in the four years from 1920 to 1924; the Automotive Wood Wheel Manufacturers, who, through the same sort of effort, quite effectually killed the growing demand for wire and disc wheels; the Greeting Card Association which has increased retail sales from ten million in 1913 to well over sixty-five million in 1925; the Joint Coffee Trade Committee which increased the per capita consumption of coffee from 9/13 pounds in 1919 to 13.15 pounds in 1925 and changed the attitude of thousands of physicians toward coffee; the Sun-Maid Raisin Growers who increased the total production from 70,000 tons in 1912 to 226,000 tons in 1925; and many others.

Unfortunately there have been a large number of association advertising campaigns that have resulted in miserable and expensive disappointment. However, in practically every such instance the failure can be traced to one or a combination of three things; faluty planning, lack of continued effort, or the absence of vigorous merchandising effort to back up the advertising as it was being expended.

For the great majority of marketing problems, a series of page advertisements in the national magazines is no panacea. Some who have contributed to association advertising schemes failed to realize that fact. Advertising is not magic but merely a form of applied selling. To yield the full measure of success it must be backed with direct mail effort, market research and analyses, publicity, dealer helps, exhibits, and all the whatnots that go together to make a complete, well-rounded campaign. To leave out one element of the campaign means to have an incomplete campaign, and nothing of this sort, which involves so much money and prestige, should be started in an incomplete form. To do so invites a disappointment and premature termination.

Associated or group advertising effort, when properly applied, will prove highly profitable to all concerned. If your industry is suffering with lack of demand or from extraneous competition (and there are many) cooperative advertising might well be seriously considered.

LEADERS OF THE WORLD

IN THESE columns, and in many thousands of other columns, editorial and otherwise, the statement has been made that the United States is the leading nation of the world. Our bump of egotism, native to man, makes this statement come easily and often. It is easy to write and easily read. Yet the fact remains that in addition to being the leading national politically, financially and industrially, we also lead the world in murders, robberies, industrial accidents and general economic waste.

In the matter of industrial accidents (only fatal cases being considered) it will be found that we annually kill, out of every million inhabitants, 860 persons. As against this France kills 477, Great Britain, 452, Japan, 466, and Denmark 223. We hope we are enjoying our preeminence in the fullest degree!

Just what it means, in a monetary sense, to kill a man, or rather to allow a man to be killed by accident, is of course beyond all calculation. It is impossible to determine the direct loss of one life, to say nothing of the indirect loss. Taking only the single and simplest cost item—that of state compensation insurance—experts have arrived at $7,500 as being the figure that represents the average cost of losing one life. With this figure we find therefore that fatal accidents are costing American industry, in compensation insurance alone, a round $700,000,000 a year. Should we add to this another single item—the direct loss of men who are rendered incapable of work for 30 days—(at $4 a day), we would have another $900,000,000. Lessened production, increased overhead, wastage of material, decreased quality of product, idle machinery time, cost to society, and countless other factors enter to make up the incalculable indirect loss.

These and even larger totals must be borne by society in general—employer and workman alike. Such cost items can result in only one thing: that of reducing our standards of living. Further, they mean increased product prices and lessened ability to compete with foreign made goods which enter in spite of existing tariff walls. If we are going to maintain our position of industrial leadership we must give more thought to the elimination of wastes and losses—human as well as material. As a nation we incline to extravagance, both with ourselves and our resources. Heretofore we have given little thought for the morrow and none at all for the day after. It is this native trait that needs correction. The responsibility for this correction rests with the employee as well as with the employer—but it is largely up to the employer to make the workman realize that fact.

VISUALIZING ANNUAL EARNINGS

AN EXCEPTIONALLY clever calendar was recently designed by Charles S. Chapman and published by the Committee on Public Relations of the Eastern Railroads. In addition to being an attractive wall piece, it very cleverly shows the avenues of expense for all Class I railroads. The twelve months of the year occupy twelve individual squares all of which appear on the single sheet instead of each being allotted a single page. This provides a full view of the entire year. Over the squares of January, February, March, April and May, has been written in heavy blue pencil the word "Wages." Over the month of June, "Fuel" appears. Over the months of July, August and a portion of September, appears the words "Material and Supplies," "Taxes and Interest" occupy practically all of October and November, with "Dividends" spreading over 19 days of December. The remaining six days in December are shown to be the period in which a "reserve fund" is set up.

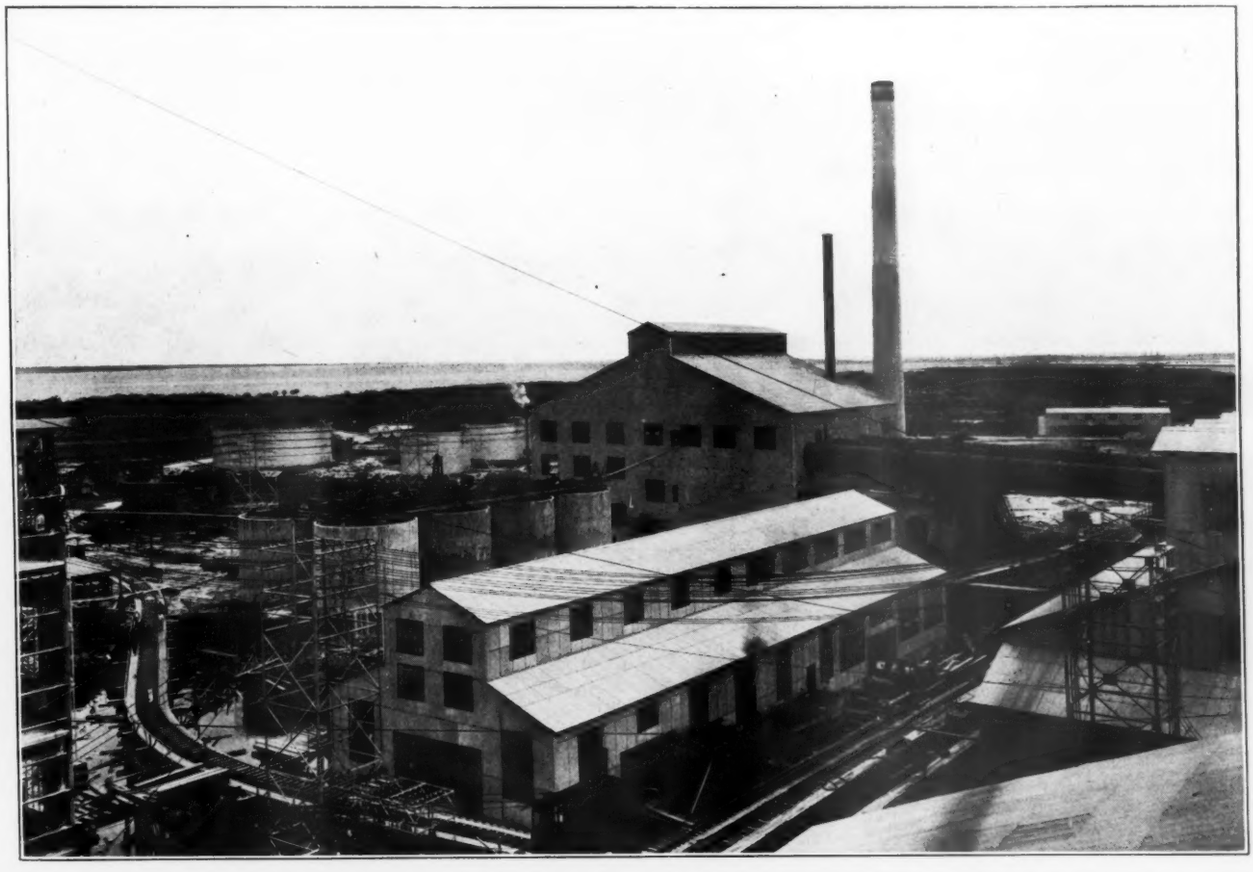
The basic facts presented in the calendar were arrived at in the following way: The aggregate gross earnings, or operating revenues were divided by 365 days. In this manner it was possible to show in terms of daily gross receipts the number of days each item of railway expense would absorb. Thus is shown, for instance, that out of the gross revenues of the year, 157 day's receipts go for wages; 27 days for fuel; 70 days for material and supplies; 24 days for other operating expenses; 41 days for interest, rents, and other fixed charges; 21 days for taxes; 19 days for dividends; and but 6 days for improvements purchased out of earnings—to make up for losses from former years—or to set up a reserve fund against lean future years.

This calendar is being displayed in the majority of the stations and other public places on practically all the Eastern railroads, and because of its graphic presentation of essential facts should clearly demonstrate to the superficially informed just where the railroad dollar goes. Such publicity is very much worth while. Invariably does such effort result in greater good to the operator or employer than any amount of acrimonious discussion over controversial questions or attempts at "industrial democracy" ventures. The clear, lucid presentation of facts provides no ground for argument. There can be no argument with truth. Nothing so effectually kills the erroneous impression that the "rail barons" are "milking the unsuspecting people" than a quickly grasped picture showing only 19 days earnings out of 365 can possibly be diverted to dividends. One picture, furthermore, is worth ten thousand words, for the average individual will not read. Particularly is this true when the message contained in the picture is as easily taken in and understood as a sign.

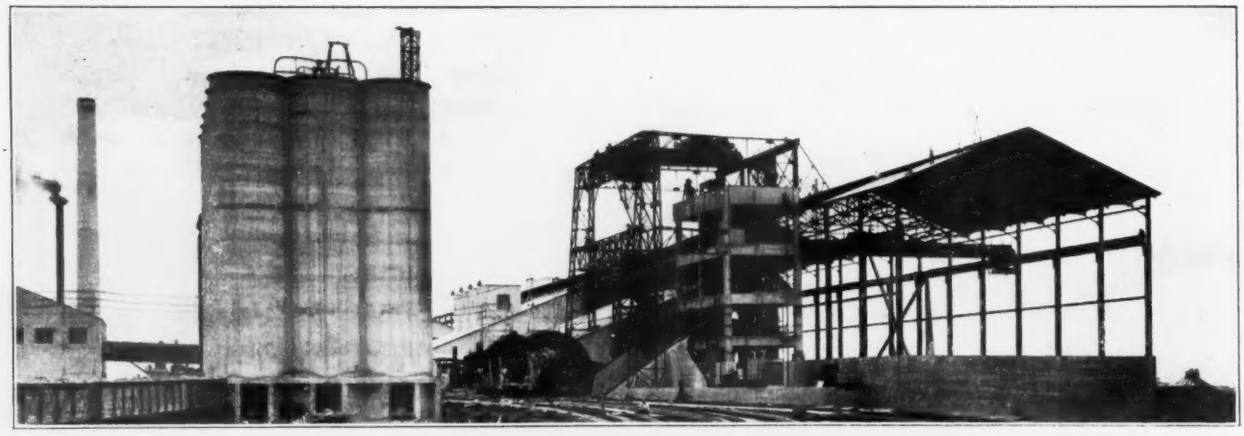
NEW CEMENT PLANT GOES INTO OPERATION WITH ORIGINAL ENGINEERING FEATURES

WITH the firing of its first kiln on September 5, the huge new $5,000,000 plant of the Florida Portland Cement Company began operations which will have a far reaching effect on the building and highway program of this section. The plant has an initial capacity of 1,500,000 barrels per year. In the efficiency of its layout, in the modern type of machinery employed, in the standardization of its engineering and construction features this new plant of the Florida Portland Cement Company is unique. Besides being one of the largest cement plants in the country, this new plant has many features of original design not to be found in any other cement plant in existence. The Cowham Engineering Company designed and built the plant and will act as operating managers. The officers of the Florida Portland Cement Company are John L. Senior, president; R. A. Drum, vice-president, and R. N. Cowham, secretary-treasurer. O. A. Hartley, who was in charge of the construction of the plant, will remain as superintendent in charge of operation. Frank M. Traynor, formerly with I. M. Shilling and Company of Miami, and previously with the Lehigh Portland Cement Company as salesmanager at Birmingham, Alabama, has been retained as director of sales. Chas. A. McKeand has the title of assistant to the president and the following officials of the Cowham Engineering Company will have charge of the operation:

Loading Rock into Standard Gondolas



View of Plant Showing Machine Shop in the Foreground. Slurry Tanks and Boiler House in Background.

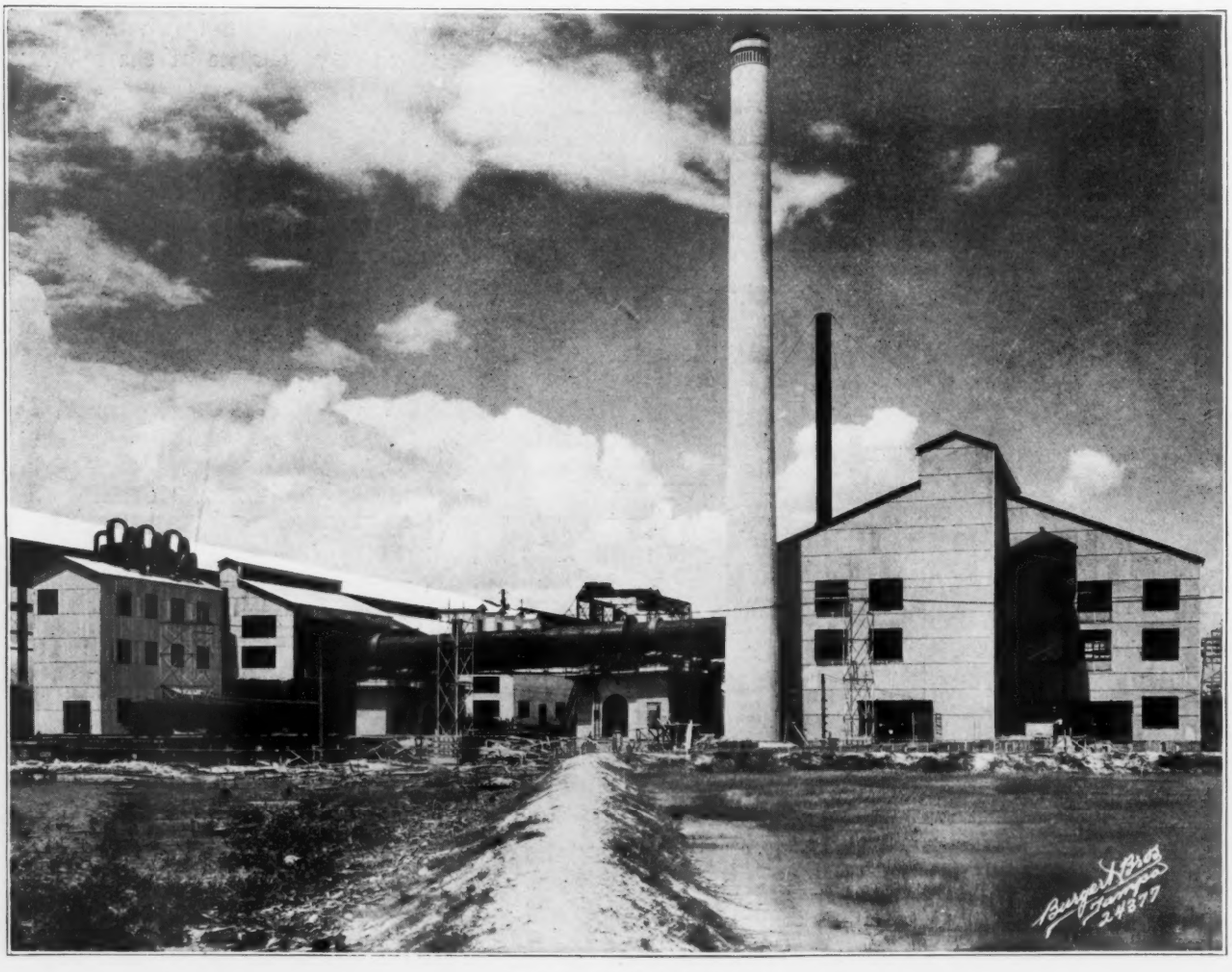


Cement Storage, Car Dumper and Rock Storage

Hiram Norcross, vice-president in charge of sales; F. P. Butler, vice-president in charge of finance; F. E. Dodge, chief engineer, and J. E. Curtis, general superintendent. Mr. Dodge had direct charge of the design and construction of the plant.

The industrial development and permanent influences that grew out of the real estate activities which attracted the attention of the entire country to Florida, have resulted in a great increase in the use of Portland cement. In 1915 Florida consumed only 483,039 barrels of cement, while for 1926 consumption approximated 5,250,000 barrels. Many advantages will accrue to the Florida Portland Cement Company because of its centralized location to the Florida market. From an analysis of 25 retail distribution points in Florida, a freight differential in favor of Tampa over mills now supplying the Florida market averages more than 50 cents a barrel. Besides having excellent railroad facilities, the plant abuts deep water where good shipping to all points is available.

The Florida Portland Cement Company's raw ma-



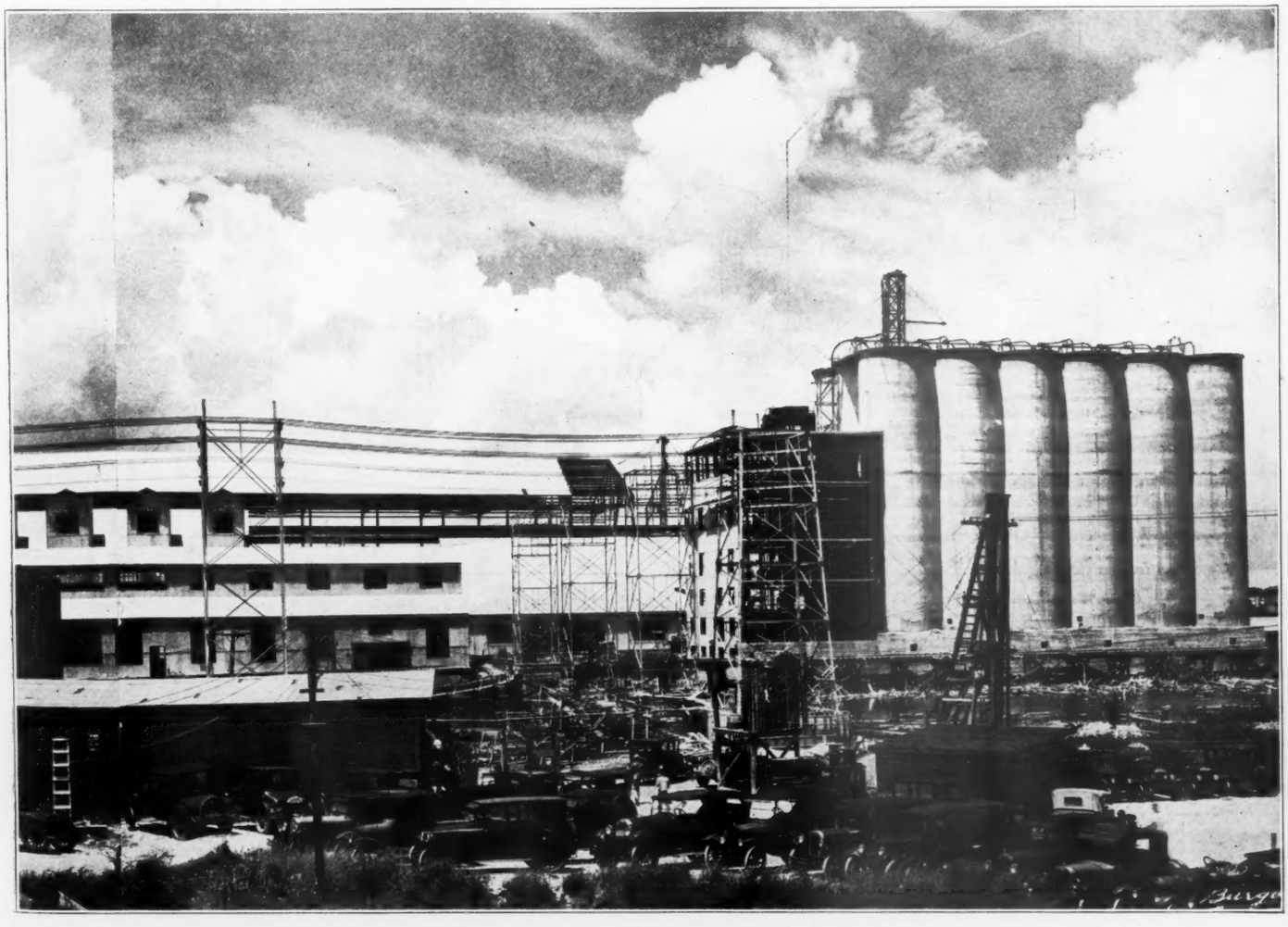
Kilns and Boiler House

terial deposits are located at Brooksville, about 50 miles north of Tampa. The deposit consists of approximately 400 acres of limestone covered by an overburden of from one to three feet in depth.

The rock is now being loaded into standard 50 ton gondola railroad cars by a Marion 61 steam shovel with 2½ yard dipper on caterpillar traction operating on a bench about 14 feet below surface. A Marion 32 steam shovel is working behind it to cut out a bench 40 feet below the surface. The gondolas are made up into trains of from twenty to thirty cars daily and are hauled by a 75 ton steam locomotive for a distance of about 4 miles to the main line of the Tampa Northern Railway (subsidiary of the Seaboard Air Line) where they are picked up and hauled the 50 miles to the company's Tampa plant.

The clay deposits are also located at Brooksville. The clay is excavated and loaded by a Northwest gas dragline directly into standard 50 ton gondola cars. About six cars a day are thus made up and at Brooksville the train of both rock and clay cars is assembled so that the daily train consists of 26 to 36 cars. Upon arrival at Tampa, the train is switched on to the Florida Portland Cement Company's private switch track and the cars backed into a Wellman-Seaver-Morgan car dump, as shown in the illustrations. This car dump is a unique piece of machinery. It rolls up a 30 degree incline and dumps the cars into a concrete pit of 30 carload capacity. This car dump is operated by a 125 h.p. General Electric motor of the direct current type, through reduction gears and a system of counterweights and cables so that the actual work of the motor is merely that of overcoming friction and furnishing the initial momentum.

A 20 ton Whiting crane of 50 foot span and operated by four General Electric motors, two of 175 h.p., one of 20 h.p. and one of 30 h.p., carrying a 4 cubic yard Hayward orange peel bucket picks the rock up from the concrete pit and dumps it into a steel hopper from which it falls to a 36 by 60 inch Fairmont roll crusher. From the roll crusher the rock drops to an Allis-Chalmers 72 inch by 16 foot rotary screen which delivers the fine material through chutes directly into storage bins and sizes the rock one inch and over to a Dixie hammermill with a revolving breaker plate which thus serves as a secondary crusher. The primary roll crusher is driven by a 200 h.p. Allis-Chalmers slip ring a.c. motor; the rotary screen by a 25 h.p. Allis-Chalmers squirrel cage a.c. motor and the ham-

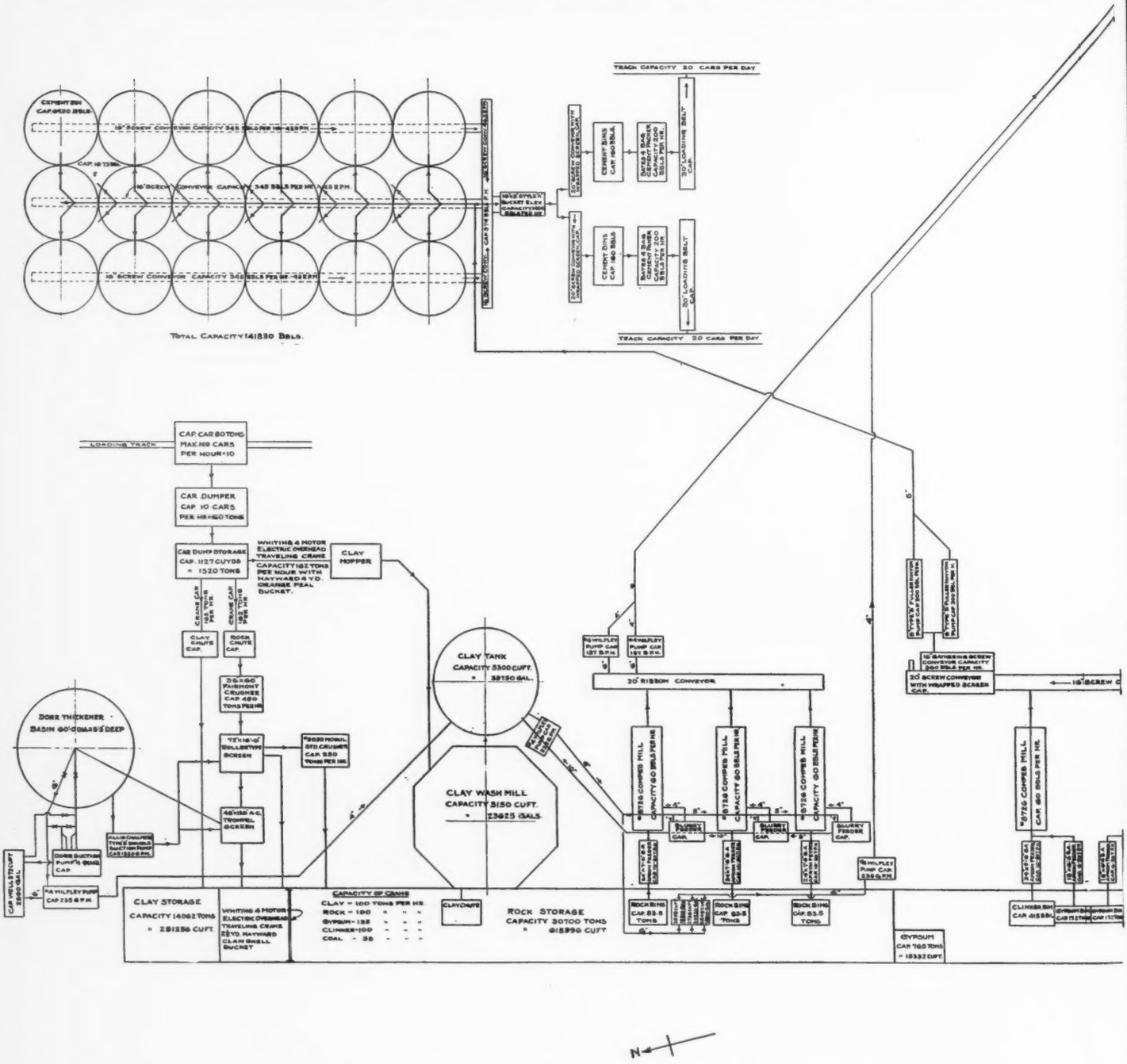


Machine Shop and Cement Storage Tanks

mermill by a 250 h.p. Allis-Chalmers slip ring motor. All motors of 50 h.p. and over throughout the plant are operated on 2200 volts a.c. while the motors of less than 50 h.p. are operated on 440 volts a.c.

The material from the secondary crusher goes to storage and is distributed by two 6½ ton Whiting cranes, each of which is operated by four buckets, to an Allis-Chalmers 26 foot wash mill. This wash mill is driven by a 75 h.p. slip ring a.c. motor through an Allis-Chalmers texrope drive, this being the only wash mill equipped with this drive in the United States.

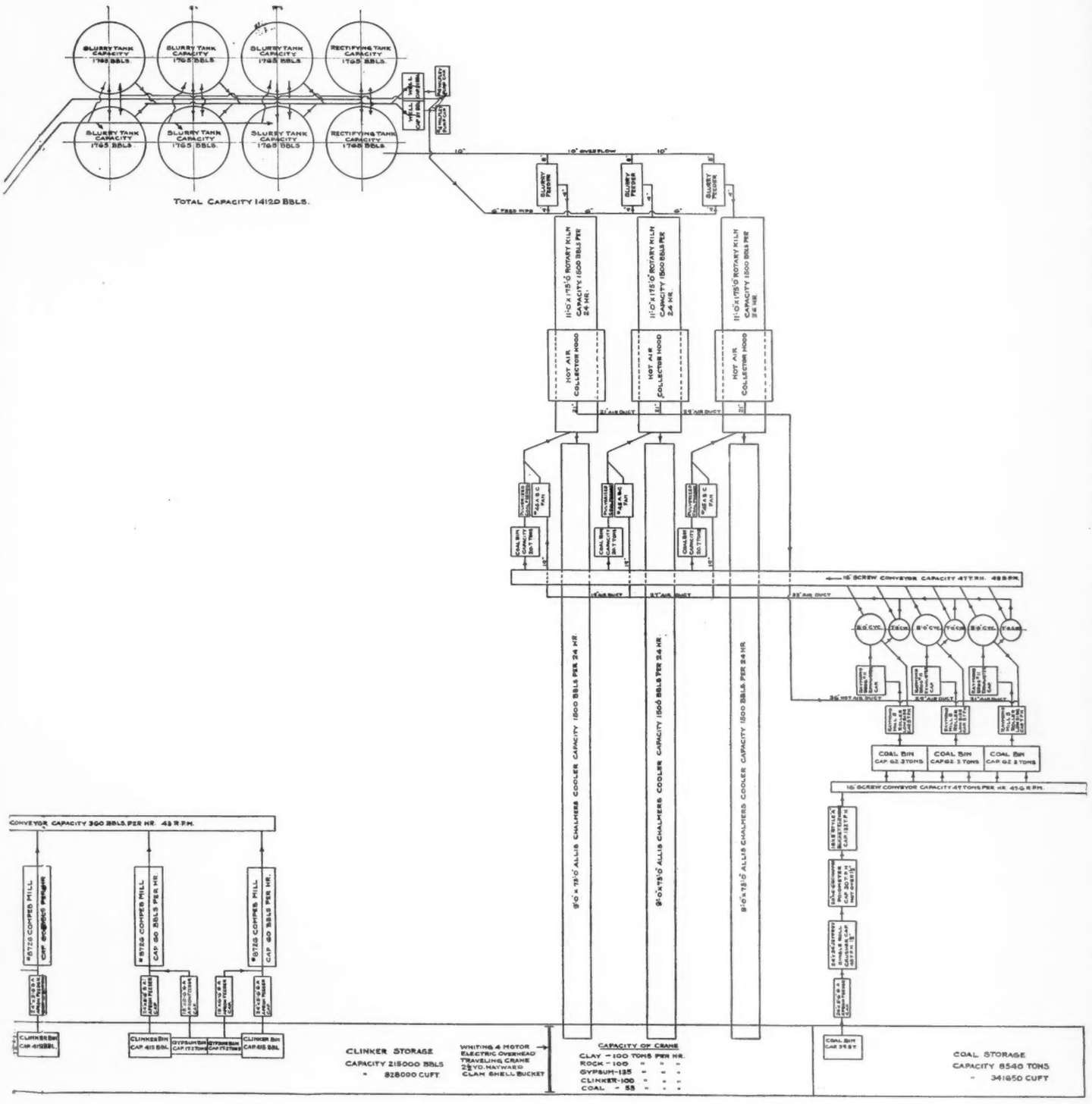
The slurry from the wash mill goes into a concrete storage tank 30 feet in diameter and 12 feet in height. From the slurry tank it is pumped by


TRACK CAPACITY 20 CARS PER DAY
TOTAL CAPACITY 141830 BBLS.
TRACK CAPACITY 20 CARS PER DAY
LOADING TRACK
CAP. CAR 80 TONS
MAX. NO CARS PER HOUR = 10
CAR DUMPER
CAP. 10 CARS PER HR = 800 TONS
CAR DUMP STORAGE
CAP. 1127 CU YDS = 1520 TONS
WHITING 4 MOTOR ELECTRIC OVERHEAD TRAVELING CRANE
CAPACITY 162 TONS PER HOUR WITH 14 HAYWARD 4 YD. ORANGE PEAL BUCKET.
CLAY HOPPER
CLAY CHUTE CAP.
ROCK CHUTE CAP.
20 x 60 FAIRMONT CRUSHER CAP. 480 TONS PER HR.
DORR THICKENER BASIN 60' DIAMETER DEEP
CLAY TANK CAPACITY 5300 CU.FT. = 39750 GAL.
CLAY WASH MILL CAPACITY 3150 CU.FT. = 23625 GALS.
20' RIBBON CONVEYOR
CLAY STORAGE CAPACITY 14062 TONS = 281256 CU.FT.
WHITING 4 MOTOR ELECTRIC OVERHEAD TRAVELING CRANE 22½ YD. HAYWARD CLAM SHELL BUCKET
CAPACITY OF CRANE
CLAY = 100 TONS PER HR.
ROCK = 100 " " "
GYPSUM = 135 " " "
CLINKER = 100 " " "
COAL = 35 " " "
CLAY CHUTE
ROCK STORAGE CAPACITY 30700 TONS = 615990 CU.FT.
ROCK BINS CAP. 83.5 TONS
ROCK BINS CAP. 83.5 TONS
ROCK BINS CAP. 83.5 TONS
GYPSUM CAP. 760 TONS = 18332 CU.FT.
CLINKER BIN CAP. 415 BBL.
N

Flow Diagram of New Plant of Florida Portland Cement Company, Tampa, Fla.

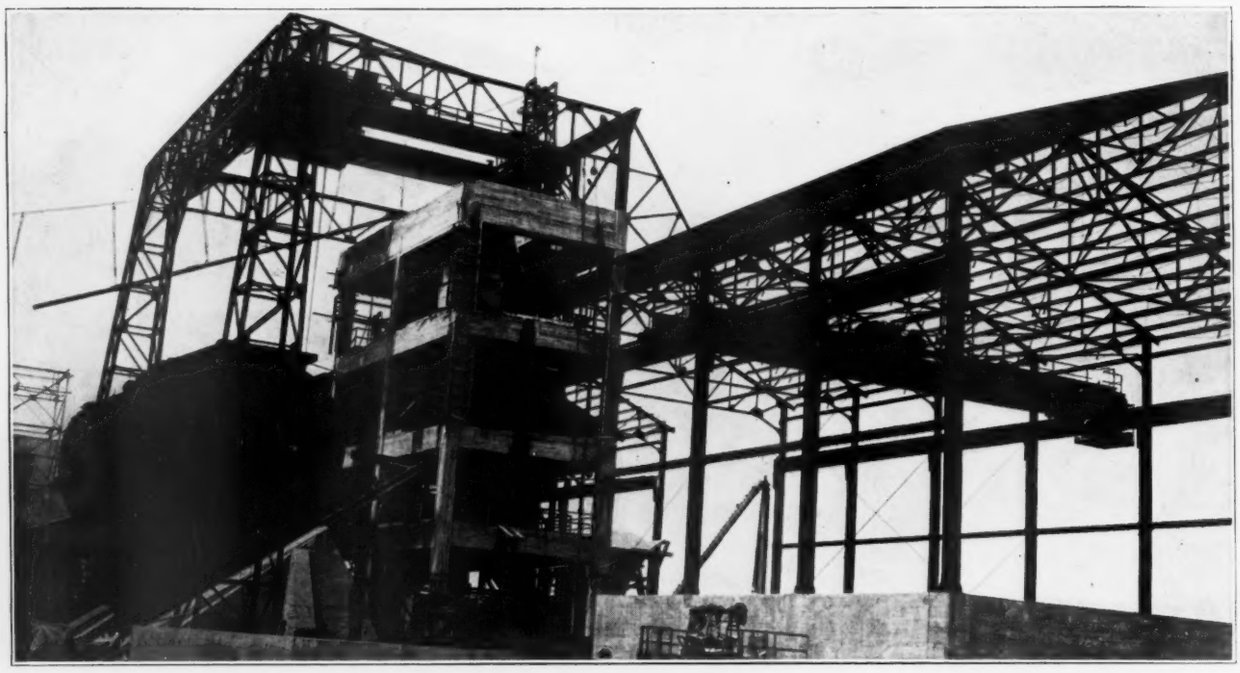
General Electric motors, three being of 50 h.p. and one of 15 h.p. On two days of each week clay is taken through the car dump to the concrete pit and hoisted by a 4 yard orange peel bucket to a hopper which spouts directly into storage. The clay is carried from storage by two 6½ ton Whiting cranes, equipped with 2½ yard Hayward clamshell means of a 4 inch Wilfley pump, equipped with a 30 h.p., direct connected, squirrel cage motor, to an Allis-Chalmers 8 by 7 by 26 foot, two compartment compeb mill. There are three compeb mills, each driven by a 550 h.p. synchronous motor through a Cutler Hammer magnetic clutch.

The rock in storage is distributed by crane to


SLURRY TANK CAPACITY 1765 BBLS.
RECTIFYING TANK CAPACITY 1765 BBLS.
TOTAL CAPACITY 14120 BBLS.
10" OVER FLOW
6" FEED PIPE
SLURRY PUMPS
SLURRY FEEDER
11'-0" x 175'-0" ROTARY KILN CAPACITY 1500 BBLS PER 24 HR.
HOT AIR COLLECTOR HOOD
21" AIR DUCT
25" AIR DUCT
33" AIR DUCT
16" SCREW CONVEYOR CAPACITY 47 TONS PER HR. 49 R.P.M.
8'-0" CYC.
COAL BIN CAP. 62.3 TONS
9'-0" x 78'-0" ALLIS CHALMERS COOLER CAPACITY 1500 BBLS PER 24 HR.
CONVEYOR CAPACITY 300 BBLS. PER HR. 49 R.P.M.
#8726 COMPED MILL CAP. 60 BBLS PER HR.
CLINKER BIN CAP. 415 BBL.
GYPSUM BIN CAP. 17.2 TONS
CLINKER STORAGE
CAPACITY 215000 BBLS
= 828000 CUFT.
WHITING 4 MOTOR ELECTRIC OVERHEAD TRAVELING CRANE 2½ YD. HAYWARD CLAM SHELL BUCKET
CAPACITY OF CRANE
CLAY - 100 TONS PER HR.
ROCK - 100 " " "
GYPSUM-135 " " "
CLINKER-100 " " "
COAL - 55 " " "
COAL STORAGE
CAPACITY 8540 TONS
= 341650 CUFT

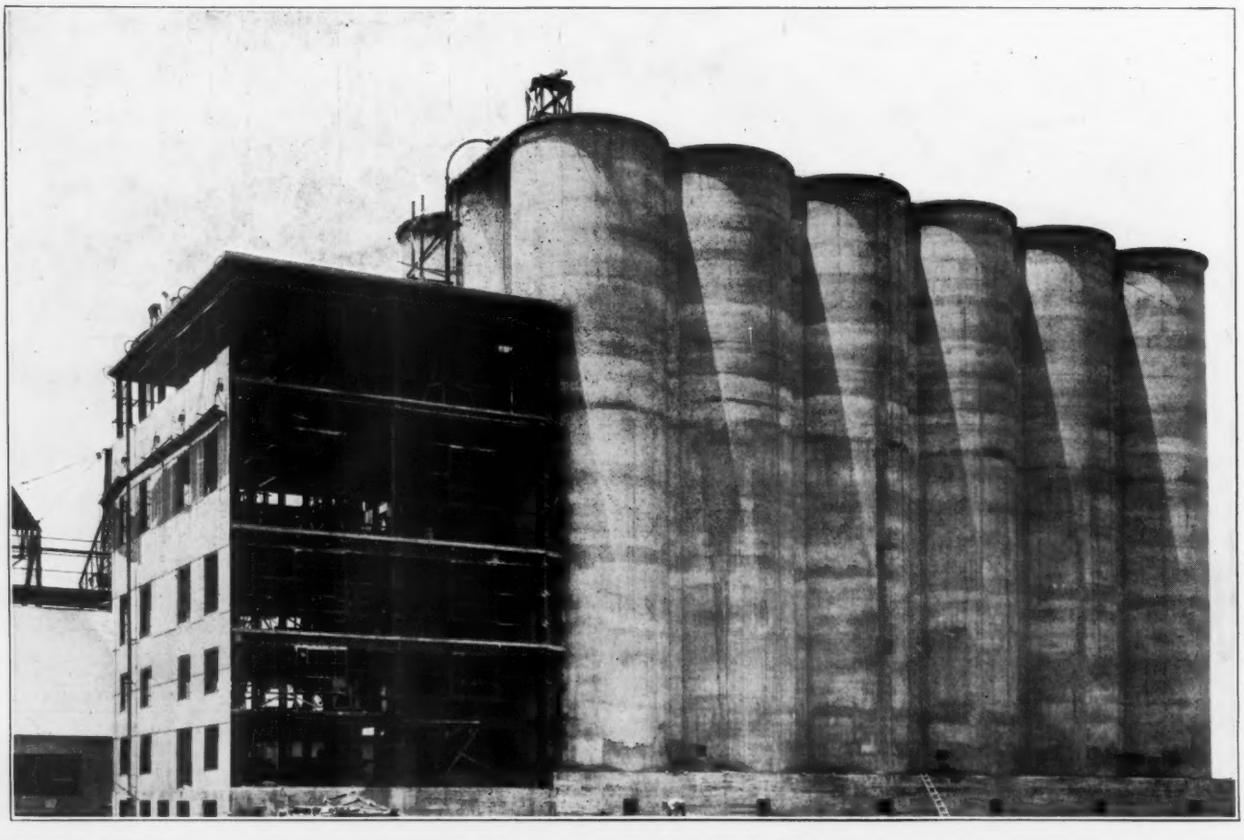
APPROVED J. E. Dodge Chief Engineer

FLORIDA PORTLAND CEMENT CO.
TAMPA, FLORIDA
COWHAM ENGINEERING COMPANY
COWHAM SYSTEM
111 WEST MONROE STREET
CHICAGO
FLOW DIAGRAM



Car Dumper and Overhead Cranes

hoppers over the compeb mills and is fed to these mills by Stephens-Adamson apron feeders equipped with 3 h.p. squirrel cage motors. At the feed end of the mill water and clay slurry is introduced with the rock. From the compeb mills the slurry drops to a concrete sump agitated by a Weller ribbon screw conveyor driven by a 15 h.p. squirrel cage motor and delivered to two 4 inch Wilfley centrifugal pumps, each driven by a 30 h.p. motor. These pumps deliver the slurry to eight slurry correcting and storage tanks. These tanks are 30 feet in diameter and 25 feet high and both air and mechanical agitation is used. Two of these tanks are reserved by the chemists for securing the proper mix. The properly mixed slurry is pumped by 4 inch Wilfley pumps, driven by 30 h.p. motors to the kiln feed tanks where it is fed into the kilns by Allis-Chalmers feeders of the

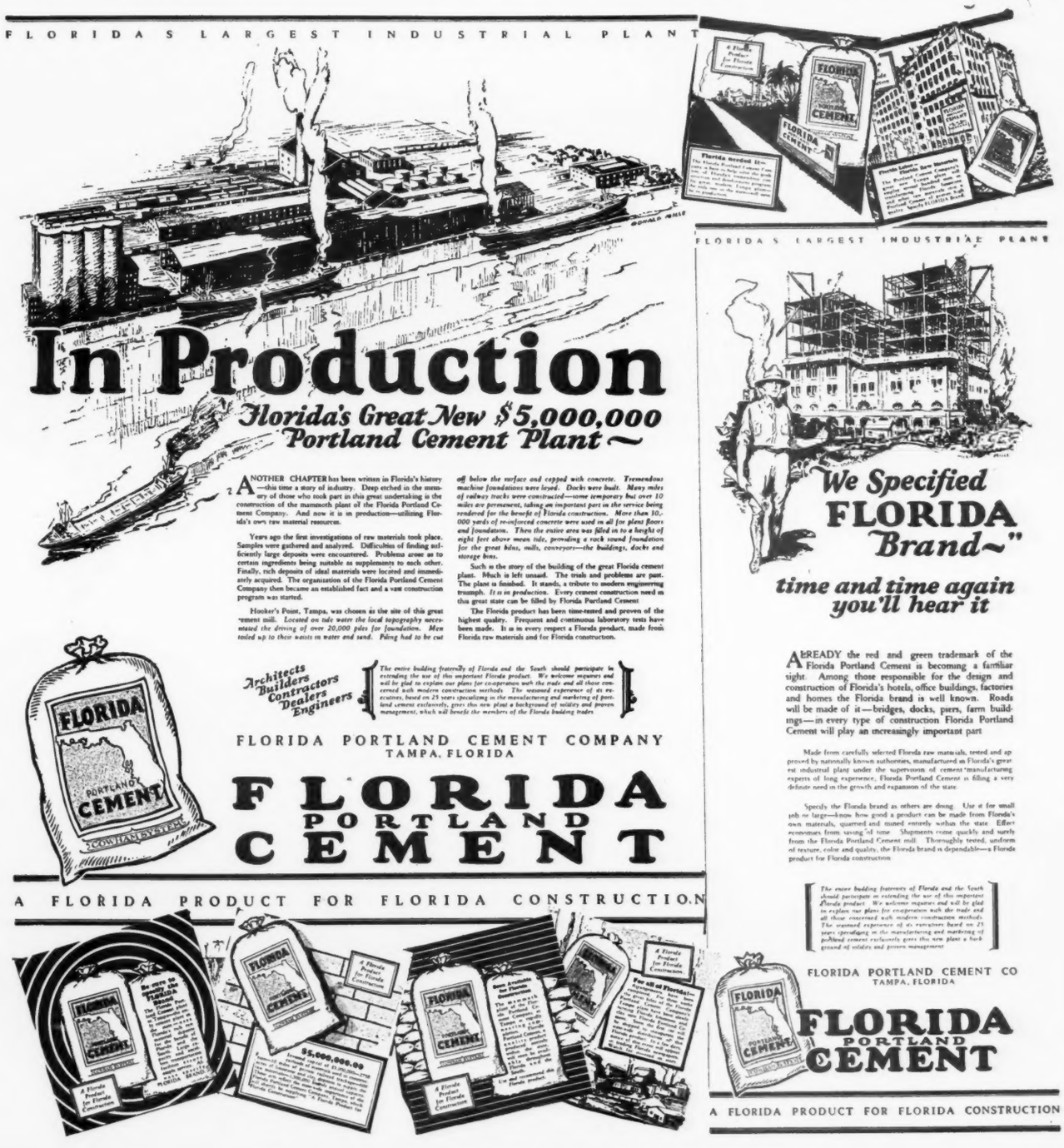


Pack House and Cement Storage Bins

Ferris Wheel type, driven by 3 h.p. squirrel cage motors.

The kilns, of which there are three, are 11 feet in diameter and 175 feet long, inclined ½ inch per foot, driven by 75 h.p., variable speed, slip ring motors, direct connected through Allis-Chalmers improved drives. The fuel used for burning the material in the kiln is powdered coal. It is fed into the kilns by a double-screw feeder, driven by a 3 h.p. motor and of a special design worked out by engineers of the Cowham Engineering Company to prevent flooding. The feeders drop the pulverized coal into a 12 inch pipe and it is then forced into the kiln by American Blower Company 7,500 cubic foot capacity blowers, driven by 30 h.p., 1800 r.p.m. squirrel cage motors. At a heat of 2,700 degrees F. to 3,000 degrees F. the clinker is formed and drops to a 9 foot diameter by 70 feet long Allis-Chalmers cooler, driven by a 40 h.p. slip ring motor and is delivered directly by the cooler to the main storage building, which is 800 feet long and 82 feet 8½ inches wide. The cooled clinker is taken to bins over the grinding mills or to storage by the 6½ ton Whiting cranes. The clinker is ground by means of four Allis-Chalmers 8726 compeb mills, being fed to the mills by Stephens-Adamson apron feeders.

From the compeb mill a 16 inch Weller gathering screw picks up the finished product and carries it to one of two Fuller-Kinyon pumps, driven by 100

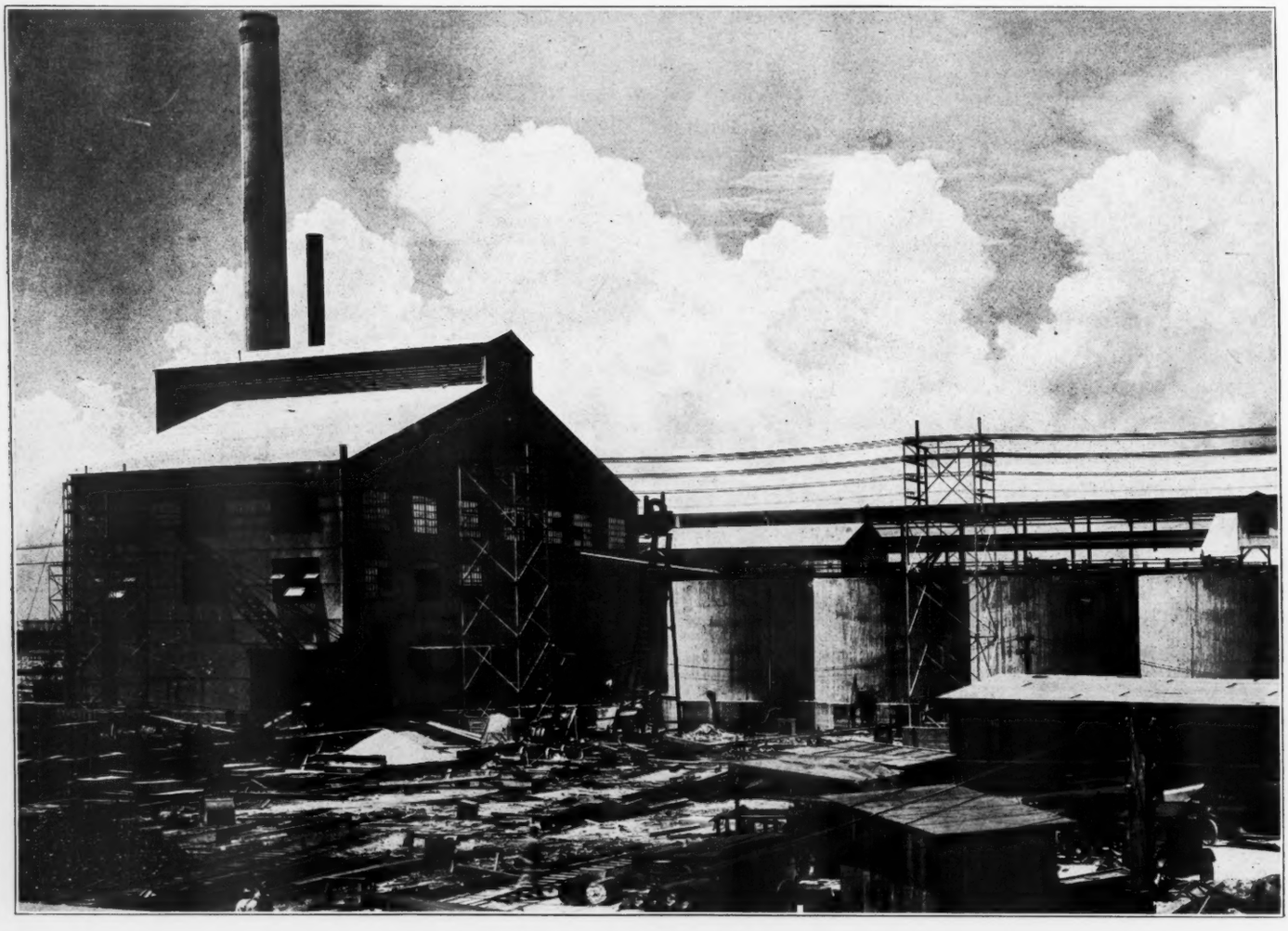

FLORIDA'S LARGEST INDUSTRIAL PLANT
In Production
Florida's Great New $5,000,000 Portland Cement Plant
ANOTHER CHAPTER has been written in Florida's history —this time a story of industry. Deep etched in the memory of those who took part in this great undertaking is the construction of the mammoth plant of the Florida Portland Cement Company. And now it is in production—utilizing Florida's own raw material resources.
Years ago the first investigations of raw materials took place. Samples were gathered and analyzed. Difficulties of finding sufficiently large deposits were encountered. Problems arose as to certain ingredients being suitable as supplements to each other. Finally, rich deposits of ideal materials were located and immediately acquired. The organization of the Florida Portland Cement Company then became an established fact and a vast construction program was started.
Hooker's Point, Tampa, was chosen as the site of this great cement mill. Located on tide water the local topography necessitated the driving of over 20,000 piles for foundations. Men toiled up to their waists in water and sand. Piling had to be cut off below the surface and capped with concrete. Tremendous machine foundations were keyed. Docks were built. Many miles of railway tracks were constructed—some temporary but over 10 miles are permanent, taking an important part in the service being rendered for the benefit of Florida construction. More than 30,000 yards of re-inforced concrete were used in all for plant floors and foundation. Then the entire area was filled in to a height of eight feet above mean tide, providing a rock sound foundation for the great kilns, mills, conveyors—the buildings, docks and storage bins.
Such is the story of the building of the great Florida cement plant. Much is left unsaid. The trials and problems are past. The plant is finished. It stands, a tribute to modern engineering triumph. It is in production. Every cement construction need in this great state can be filled by Florida Portland Cement
The Florida product has been time-tested and proven of the highest quality. Frequent and continuous laboratory tests have been made. It is in every respect a Florida product, made from Florida raw materials and for Florida construction.
Architects Builders Contractors Dealers Engineers
The entire building fraternity of Florida and the South should participate in extending the use of this important Florida product. We welcome inquiries and will be glad to explain our plans for co-operation with the trade and all those concerned with modern construction methods. The seasoned experience of its executives, based on 25 years specializing in the manufacturing and marketing of portland cement exclusively, gives this new plant a background of validity and proven management, which will benefit the members of the Florida building trades
FLORIDA PORTLAND CEMENT COMPANY
TAMPA, FLORIDA
FLORIDA PORTLAND CEMENT
A FLORIDA PRODUCT FOR FLORIDA CONSTRUCTION
FLORIDA'S LARGEST INDUSTRIAL PLANT
We Specified FLORIDA Brand~"
time and time again you'll hear it
ALREADY the red and green trademark of the Florida Portland Cement is becoming a familiar sight. Among those responsible for the design and construction of Florida's hotels, office buildings, factories and homes the Florida brand is well known. Roads will be made of it—bridges, docks, piers, farm buildings—in every type of construction Florida Portland Cement will play an increasingly important part
Made from carefully selected Florida raw materials, tested and approved by nationally known authorities, manufactured in Florida's greatest industrial plant under the supervision of cement manufacturing experts of long experience, Florida Portland Cement is filling a very definite need in the growth and expansion of the state
Specify the Florida brand as others are doing. Use it for small job or large—know how good a product can be made from Florida's own materials, quarried and mined entirely within the state. Effect economies from saving of time. Shipments come quickly and surely from the Florida Portland Cement mill. Thoroughly tested, uniform of texture, color and quality, the Florida brand is dependable—a Florida product for Florida construction
The entire building fraternity of Florida and the South should participate in extending the use of this important Florida product. We welcome inquiries and will be glad to explain our plans for co-operation with the trade and all those concerned with modern construction methods. The seasoned experience of its executives based on 25 years specializing in the manufacturing and marketing of portland cement exclusively gives this new plant a background of validity and proven management
FLORIDA PORTLAND CEMENT CO
TAMPA, FLORIDA
FLORIDA PORTLAND CEMENT
A FLORIDA PRODUCT FOR FLORIDA CONSTRUCTION

Some Examples of the Excellent Advertising Used by the Company

h.p. squirrel cage motors. These pumps deliver the product to the cement storage silos, of which there are 18 circular bins 20 feet in diameter and 85 feet in height and 10 irregular shaped bins. The total storage capacity of these bins is 141,000 barrels. Three tunnels under the silos draw off the stored cement and deliver it to a Weller cross conveyer driven by a 10 h.p. motor and thence to a Weller elevator, driven by a 20 h.p. motor, which delivers the material through a screen to the packer bins. Under these bins are two Bates four tube packing machines, driven by 25 h.p. squirrel cage motors. The packing machines deliver to a 16 foot centers Weller belt driven by a 5 h.p. squirrel cage motor, which carries the cement in bags directly to the railroad cars on tracks on either side of the silo storage structure. Wherever possible all drives throughout the plant are direct connected through Jones spur gear reduction units. The air compressors and the washmill are operated by Allis-Chalmers texrope drive and except for the Fairmont roll crushers and the Ferris wheel slurry feeders there are no belted drives in the entire plant, which plan gives the greatest possible factor of plant safety.

Another unique feature of the plant is the coal mills, being one of a very few in the country operated without a coal dryer. The equipment of this mill consists of three Raymond five-roller mills, driven by 75 h.p. squirrel cage motors. A fan on the discharge side of these mills, driven by a 40 h.p. squirrel cage motor, draws hot air through the mill from a hood placed over the burning end of the kilns. This air is maintained at a temperature of 360 degrees F. and is adequate to drive off enough moisture to permit efficient grinding in the mills. The pulverized product is delivered, through the cyclones which are a part of the Raymond Mill installation, directly into a Weller Mfg. Co. coal feed screw over the three coal feed bins which supply the kilns. The cyclones are driven by a 40 h.p. squirrel cage motor and the feed screw by a 25 h.p. squirrel cage motor.

The buildings at the plant include a storage 82 feet, 8½ inches wide by 800 feet long, which is divided into a clay storage 82 feet, 8½ inches by 100 feet, a rock storage 82 feet, 8½ inches by 250 feet, a gypsum storage 30 feet by 50 feet, a clinker storage 82 feet, 8½ inches by 300 feet and a coal storage 82 feet, 8½ inches by 150 feet. The Dorr thickener is 60 feet in diameter by 5 feet 5 inches deep.



Boiler House and Slurry Tanks

The rock crushing building is 75 feet by 101 feet 6 inches; the raw grinding building 75 feet by 125 feet; the finish grinding building 90 feet by 100 feet; the coal mill building 23 feet by 67 feet and the burning platform 50 feet by 75 feet. The general store room is 50 feet by 80 feet; the machine shop 50 feet by 80 feet; the packing house 40 feet by 61 feet; the boiler house 76½ feet by 100 feet and the turbine room 56 feet by 75 feet. The descriptions and capacities of the various units of the plant are shown in the following table:

The plant is equipped with waste heat boilers which provide for the utilization of waste heat from the cement kilns for making steam to provide power and light for the entire plant. This installation, in addition to increasing the capacity of the kilns, results in a saving of from $50,000 to $75,000 per year in the cost of power.

Description	Number	Type	Capacity
Car Dumper	1	Wellman-Seaver-Morgan	Ten cars per hour
Car Dumper Storage Pit	1	concrete	1520 tons
Crane	1	Whiting 20 ton	162 ton per hour
Roll Crusher	1	Fairmont 36″x60″	450 ton per hour
Rotary Screen	1	Allis-Chalmers 72″x16′	
Trommel Screen	1	Allis-Chalmers 48″x120″	
Double Suction Pump	1	Allis-Chalmers type "S"	1350 gal. p. m.
Pumps	3	Wilfley No. 4	235 gal. p. m.
Clay tank	1	concrete	39,750 gallons
Clay Wash Mill	1	Allis-Chalmers 26′	23,625 gallons
Hammermill	1	Dixie	250 tons per hour
Clay Storage	1	concrete	14,062 tons
Crane	1	Whiting with 2½ yd. Hayward clam shell bucket	Clay—100 tons per hr. Rock—100 tons per hr. Gypsum—135 tons per hr. Clinker—100 tons per hr. Coal—58 tons per hr.
Rock Storage	1	concrete	30,700 tons
Pumps	2	Wilfley No. 4	187 B. P. M.
Ribbon Conveyor	1	Weller Mfg. Co. 20″	
Compeb Mill	7	Allis Chalmers No. 8726	60 B. P. M. each
Rock Bins	3	steel	83.5 tons each
Gypsum Storage	1	concrete	765 tons
Pumps	2	Fuller Kinyon Type "B"	300 B. P. H. each
Gathering Screw	1	Weller Mfg. Co. 16″	360 B. P. H.
Screw Conveyor	1	Weller 20″ wrapped screen	
Apron Feeder	8	Stephens-Adamson	6-30 T. P. H. each
Clinker Bins	4	steel	415 barrels each
Gypsum Bins	4	steel	17.2 tons each
Slurry Tanks	8	concrete	1765 barrels each
Rotary Kilns	3	steel	15 barrels per 24 hrs. each
Coal Bin	1	steel	39.5 tons
Coal Crusher	1	24″x24″ Jeffrey single roll	40 T. P. M. 1½″
Poidmeter	1	20″x4′ 6″ Schaffer	30 T. P. M. not over 1½
Bucket Elevator	1	Weller 16″x8″ style A	132 T. P. M.
Screw Conveyor	1	Weller 16″	47 tons per hour
Coal Bins	3	steel	62.3 tons each
Coal Mills	3	Raymond fine-roll	5 T. P. H. each
Coal Bins	3	steel	20.7 tons each

The plant in its entirety is well balanced to insure facilities for two ocean-going freighters will age facilities for two ocean-going freighters will provide for unloading of raw materials or fuel and loading of the finished product simultaneously.

Value of Inspiration

There can be no estimate of the value of inspiration. Without it and the initiative of individual profit afforded by our form of government we would be a nation of serfs and slaves.

Inspiration is as varied in form as the individual. It may come through a simple, unintentional remark by a friend, from a paragraph in some prosiac publication, from song, poetry, employee or employer, the Holy Bible, or from one's wife or child. How many countless thousands of men have been spurred to greater effort and larger success by the conscious or unconscious inspiration of wives? The thought or words of a patient, loving mother have been of incalculable value in raising the standards of living for humanity.

Inspiration can perhaps best be supplied in literature form. Not long ago a sales manager employed an exceptionally clever "inspirational speaker" to talk before his sales convention. In addition, at the plate of each salesman there was placed a copy of Douglas Malloch's new book "Be The Best," marked by the insertion of a card: "With the compliments of . . . . ." The very binding of the book was so as to command respect and impel gratitude for the gift. Within were scores of little poems by the author, each of the wholesome, subtle kind that applies inspiration unconsciously. It was later remarked by this sales manager that his sales volume increased 22 per cent during the ensuing months—largely due, in his opinion, to the provision of the book which each could take away with him and read as occasion permitted.

ANALYSIS OF DEHYDRATION OF GYPSUM

DEHYDRATION of gypsum, $CaSO_4.2H_2O$, by heat is effected in two stages, the first stage corresponding to the semihydrate, $CoSO_4.1/2\ H_2O$ and the second stage to the anhydrite, $CoSO_4$. The classic studies that were made by Le Chatelier (see H. Le Chatelier, Comptes rendues, volume 96, pages 1666 year 1883) and by Van't Hoff (see Van't Hoff, Ozean, Salt Deposits, 1912) have clearly established this fact, but nevertheless a definite agreement relative to the exact limits of the zones of stability of the various modifications of gypsum is still far from being realized at the present time.

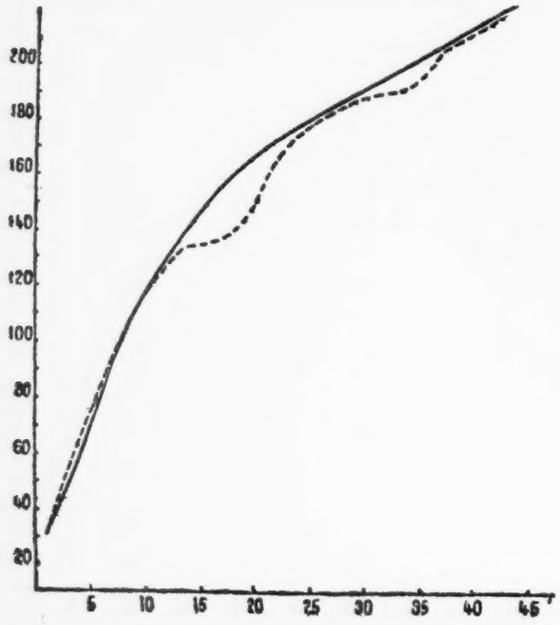


Fig. 1. Heating Curves of Gypsum and Check Test

As the investigations of Jolibois and Lefevre (Jolibois and Lefevre, Comptes rendues, volume 176, pages 1317ff, year 1923) and of Linck and Jung (Link and Jung, Zeitschrift fuer anorganische und allgemeine Chemie, volume 137, pages 407ff, year 1924) have shown the primary influence of the experimental conditions on the course of the dehydration of gypsum, we have proposed to study this influence in somewhat more detail, and in this study we have made use of the metallographic method of thermal analysis. With this idea in mind two small test tubes containing the gypsum are immersed in a bath of oil, one of which is filled with chemically pure gypsum in the pulverized state, and the other with amorphous silica which has been calcined at a temperature of 1,100 degrees C. During the rise in temperature, the following observations were made every half minute. In the first place the temperature in the main body of the gypsum was observed, then that of the silica and in the third place the deviations in a differential galvanometer which gave the differences in potential of a thermo-electric platinum rhodium-plantinum couple whose junctures were immersed in the tubes.

The experiments were carried out in such a fashion that the variable speeds of dehydration were obtained, these being measured by means of the speed of the heating of gypsum and the silica. Each experiment was repeated a number of times and we can state that in general the results obtained were duplicated in the repeated experiments with a remarkable degree of accuracy, with the exception of the experiments that were made at very high speeds of dehydration, the results of these experiments being subject to appreciable variation.

Reproduced here are the results of these experiments making use of three very characteristic curve diagrams which show the behaviour of the gypsum in a graphical representation.

In the first instance the speed of heating was at the rate of two and one half degrees Centigrade rise per minute. These experiments showed the existence of two stages of dehydration. The first, corresponding to the semihydrate, took place at a temperature of 125 to 127 degrees C, and the second, that of the anhydrite, took place at a temperature of 190 degrees C. The curves that were obtained are nevertheless not so clearly defined as those which were obtained in the other tests.

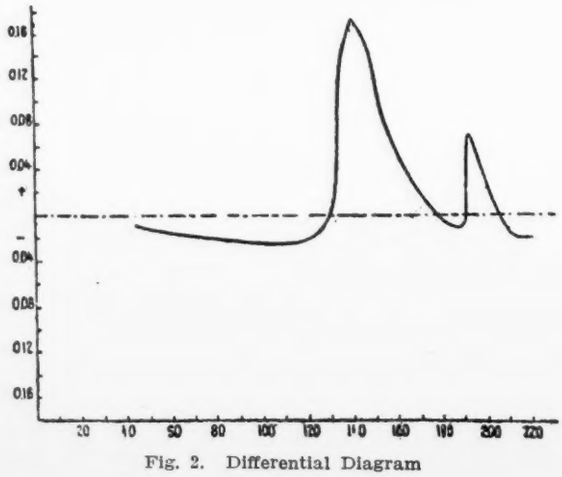


Fig. 2. Differential Diagram

In the second case the speed of heating was at the rate of four and one half degrees Centigrade per minute. The heating curve (see figure 1) of gypsum, shown in dotted lines on the curve diagram, possesses two very clearly defined level stretches, the first being seen at a temperature of 134 degrees C and the second at a temperature of 190 degrees C. These are points in the cessation of the rise of temperature and furthermore the differential method also gives results which agree very well with these, as may be seen from figure 2.

(*Continued on page 78*)

RAILWAY LOCOMOTIVE SHOPS TRANSFORMED INTO CEMENT MANUFACTURING PLANT

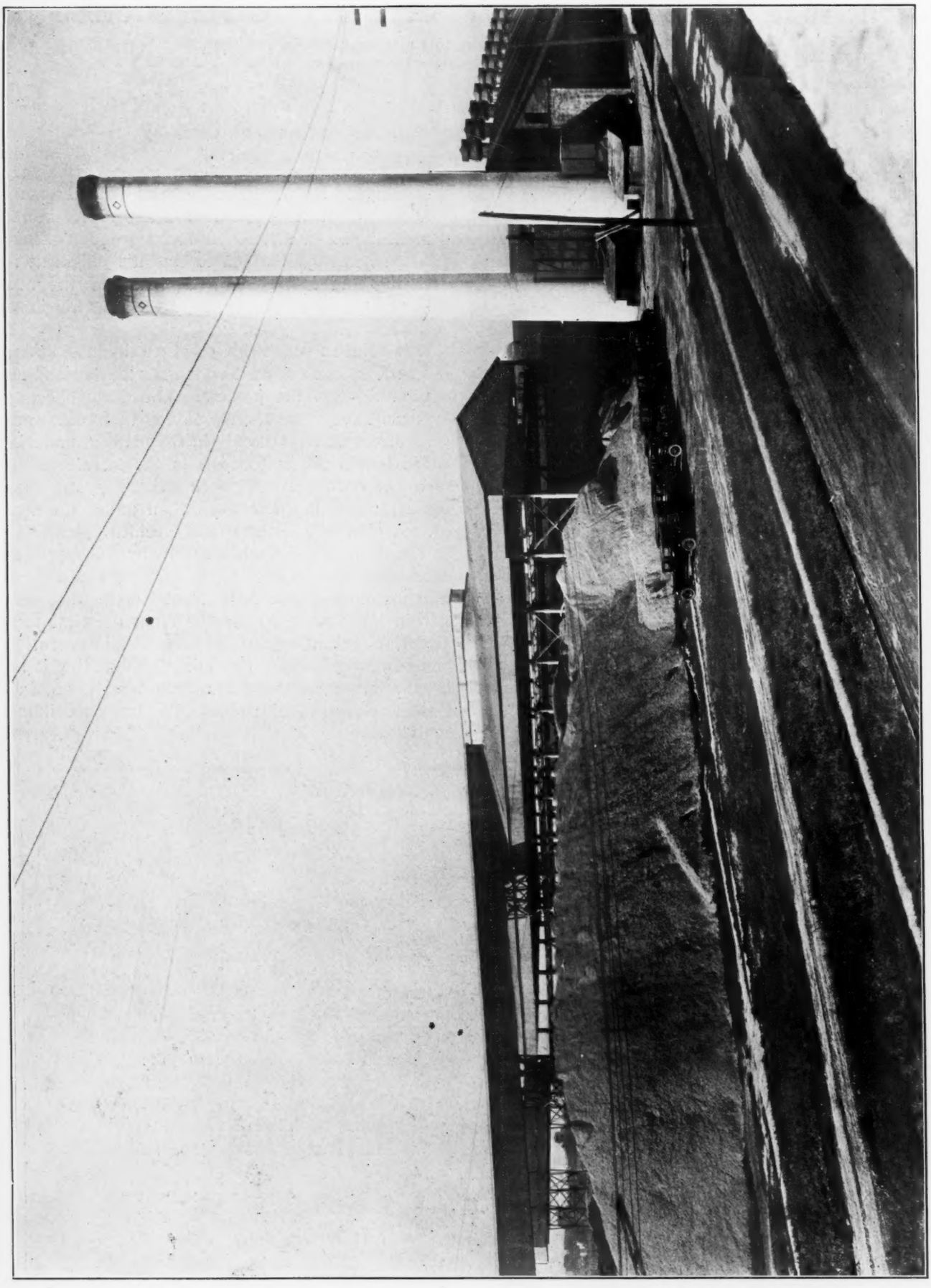
By C. J. Quail,
Construction Engineer, New Egyptian Portland Cement Company

MANUFACTURE of locomotives and Portland cement can hardly be considered as closely allied processes. However, in the year 1922 when the Grand Trunk Railway System offered for sale the Fort Gratiot Locomotive Shops at Port Huron, Michigan, it remained for the experienced eye of the cement engineer to grasp the opportunity and see that the old buildings heavily constructed of brick and masonry were almost ideally arranged for the installation of a cement plan of the most modern type. This engineer was Mr. J. A. Acker, assistant general manager of the New Egyptian Portland Cement Company already operating a plant at Fenton, Michigan. The company having completed the purchase of the property, Mr. Acker moved onto the job and plans were completed for the installation of machinery and the erection of storage buildings. The main buildings already on the site consisted of one long building with three branches arranged in the form of the letter "E". These buildings were all connected which simplified the heating problem and also made possible a very compact unit. Notwithstanding the fact that the biuldings are old, it was the policy of Mr. Acker to insist upon the most modern machinery and methods in order to obtain maximum efficiency in operation. Much of the machinery was designed by him in conjunction with the manufacturers. Having had a life's experience in the cement business, Mr. Acker had a wonderful field of experience upon which to base his judgment in choosing and arranging equipment for the new plant and later results have proven that his judgment has seldom erred.

One point in which this plant excells most others is in the absence of dust which is collected and returned through the process. The dust collecting systems have more than paid for their cost each year of operation, not only in the price of material saved but in the betterment in the morale of the men, who work much more efficiently and take more interest in their work than under the conditions obtained in the average cement plant.

The main building being 250 by 70 feet was chosen for the kilns. It was laid out for a three kiln installation and it is a noteworthy fact that within less than nine months from the time construction started, one of the kilns was in operation and cement was being ground. This building is located approximately 400 feet from the river and at right angles to the dock line. The branch building constituting the leg of the letter "E" lying nearest

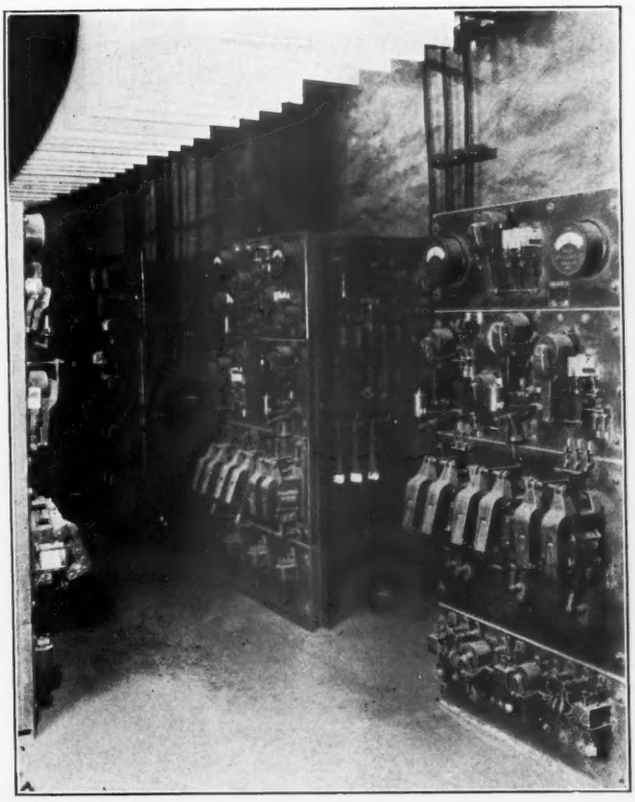
Steamer Unloading Limestone at the Rate of 10,000 Tons in Six Hours



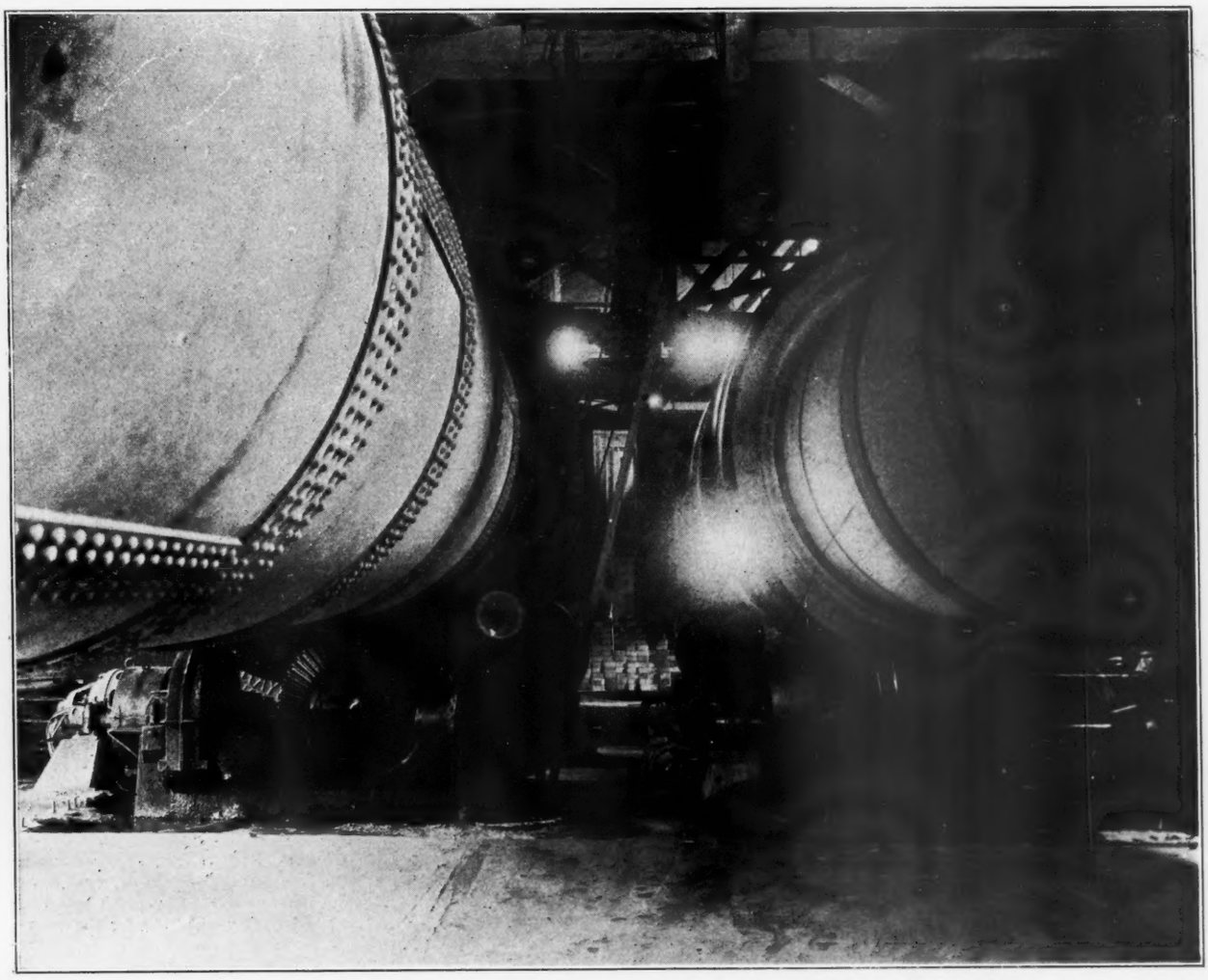
Showing Rock Storage Craneway With Belt Conveyor Gallery From Boat

the dock line and parallel to it was chosen as the raw mill. This building conveniently houses four raw grinding tube mills, six 20 by 20 foot slurry tanks and four 20 by 20 foot clay tanks. Adjoining this building toward the river and parallel to it was constructed the rock and clay storage, a steel building 300 by 80 feet equipped with a 7-ton Milwaukee crane operating a clamshell bucket. With this bucket crushed limestone is delivered to the raw grinding mill hoppers and clay to the wash mill, which is located at the south end of the building. Only one man is thus required to operate the crane each shift.

In order to decrease the handling of clay to a minimum, it is delivered directly from the cars in which it comes to the plant into the wash mill. However, in order to guard against shipping delays, a surplus stock pile of about 4000 tons of clay is maintained at all times. Clay is ground in a 20 foot F. L. Smidth wash mill until it has reached a consistency of about 60 per cent water and it is then pumped to the storage tanks by a 4-inch Morris centrifugal pump directly connected to a 25 h.p. vertical Westinghouse motor. The pump was especially designed to Mr. Acker's specifications and is standardized throughout wherever clay



Main Line Switch Board Room



Kiln Drives. Motors (100 h. p.) Driving Gear Train Through Silent Chain Reduction

or slurry has to be conveyed. The wash mill is driven by a 50 h.p. Westinghouse motor through a Link Belt silent chain drive. The clay tanks are provided with mechanical agitators to prevent separation. Clay is pumped from these tanks as required and delivered to a steel tank at the head of the raw grinding tube mills where Ferris wheel feeders take out just enough for proper mixture with the rock while the remainder flows back to the pump sump.

Limestone is delivered at the plant from Rogers City, Michigan, in 10,000 ton boat loads. It is in

The above two illustrations show two methods of using a scraper when working in storage. The lower illustration shows a power drag scraper moving stone away from the craneway. The upper illustration shows a scraper hoist mounted on a caterpillar crane with the boom serving as a most.

The outside storage pile is built up by the scraper to a height of 30 feet and a width of 200 feet for the full length of the craneway. Loops of cable secured at intervals to the uprights of the craneway supply a series of anchorages for the tail block of the scraper system. This block is fitted with a hook so it is easily shifted from one anchorage to another while the auxiliary conveyor that feeds the rock into the yard is moved along by the overhead crane to correspond with the postiion of the scraper, and as the head end of the scraper installation is virtually a self moving tower, the equipment can be rapidly moved the full length of the yard. In the winter the scraper bucket is turned around and the stone is dragged back within reach of the overhead of the crane.

the form of quarry screenings ¾ inch and under which is a very convenient form of handling. The boats used in this service are of the most modern type, being fitted with complete unloading conveyor belt equipment. The rock which is carried in a series of hoppers in the hold is fed to the belts which deliver to an elevator in the bow which in turn discharges to a belt on a swinging boom. As the boat docks this boom is swung around until the end of the belt is in position to discharge into the stationary hopper on shore.

Beneath this receiving hopper is the end of a 54 inch belt conveyor 319 foot centers which delivers the rock to the storage building. This conveyor is driven by a 150 h.p. Westinghouse motor and has a speed of 600 feet per minute. The belt conveyor gallery is of the overhead truss type designed to give the belt an incline of eleven degrees. In order to reduce vibration, the conveyor is driven from the tail end making it possible to locate the driving mechanism close to the ground. A feature of this conveyor is that all carrier rolls are mounted on roller bearings, thus reducing power consumption to a minimum.

The main conveyor delivers stone to a cross shuttle conveyor located lengthwise the center of the rock storage. This building is 300 feet long, 80 feet wide and 33 feet from floor to top of crane rail, with longitudinal axis transverse to the main belt. The shuttle conveyor is 54 inches by 150 foot centers and is mounted on a steel track. Equipped with a traction mechanism and reversible drive, this conveyor will distribute stone at any point the entire length of the storage.

With this equipment the average time for unloading a 10,000 ton boat load of rock is six hours, or 1,666 tons per hour. The capacity of the rock storage is 30,000 tons which provides an ample surplus during the shipping season. During the winter months while navigation is closed, it is necessary to store enough rock to keep the plant in operation. For the two kilns about 110,000 tons are required for this period. In order to supplement the storage within the craneway a Sauerman one yard Crescent power dragline is provided which operates during the summer months to convey stone out of the craneway into a stock pile and in the winter months is reversed to drag back into

Traveling Crane Handling Rock in Storage Building

the building. By this means a practically unlimited rock storage is provided at an exceedingly low initial as well as operating cost.

Clay is brought in from the company's pit at Smith's Creek about 12 miles from the plant by rail in standard equipment. The clay obtained from this source is remarkably well adapted for the purpose of making cement, not only in its chemical nature but from its absolute freedom from gravel or boulders. This latter quality reduces repairs and cleaning on mixing machinery to a minimum.

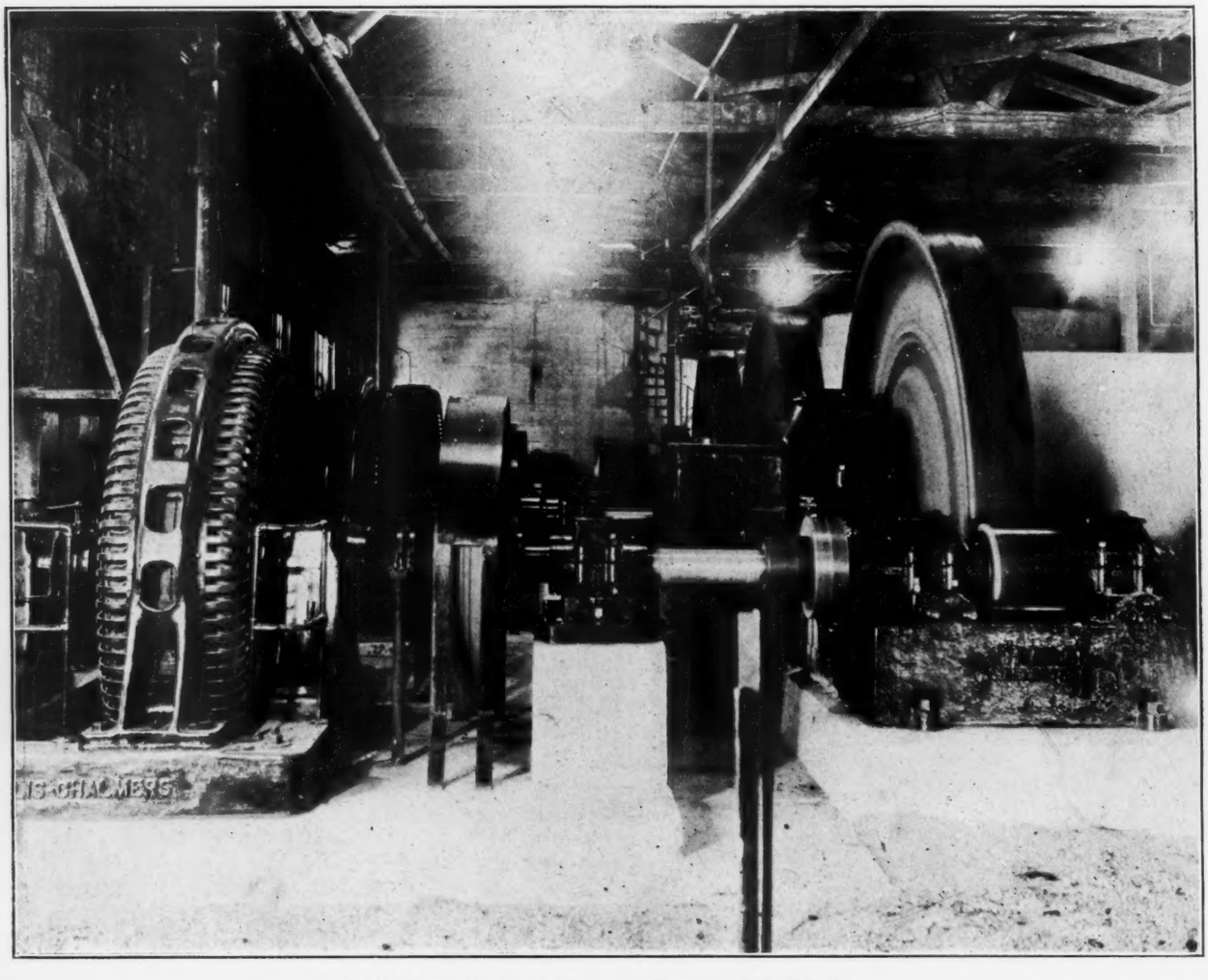
Grinding and Burning

Rock deposited in hoppers by the electric crane in the storage is drawn out by means of Schaffer poidometers and fed through a Jeffrey swing hammer mill which reduces the maximum size particles from ¾ inch to ¼ inch. The rock and clay is then fed directly into the tube mills. The raw grinding is done by three 7 by 26 foot Traylor 3 compartment tube mills driven by 500 h.p. synchronous motors through 60 inch Cutler Hammer magnetic clutches. The first compartment of the mill is loaded with 4 inch, the second 2½ inch and the third with 1¼ inch balls.

The discharge from the mills goes to a common sump from which it is delivered by a 4-inch pump to six 20 by 20 foot slurry tanks, equipped with agitators to prevent segregation of the ingredients. Slurry from these tanks is pumped to small open tanks above the ends of the kilns. These are equipped with Ferris wheels which feed the slurry into the kilns at a definite rate. An overflow pipe returns excess slurry to the pump sump. The rate of pumping is purposely set greater than the Ferris wheel capacity in order to allow for variations in efficiency of the pump due to wear or other causes.

At present there are two kilns in place, each 11 by 200 feet supported on two bearings. They are lined for the first 160 feet from the firing end with fire brick, the remainder being left bare. The kilns were built by the Traylor Engineering and Manufacturing Company and are driven by 100 h.p. Westinghouse variable speed motors. The initial reduction is made by silent chain drive in order to eliminate the noise and wear of high speed gears.

The average capacity of the two kilns has been 1685 barrels each per day. This high capacity is primarily due to the Acker-Cheeseman patented combustion system in use at this plant. This system which was evolved and patented by Mr. Acker



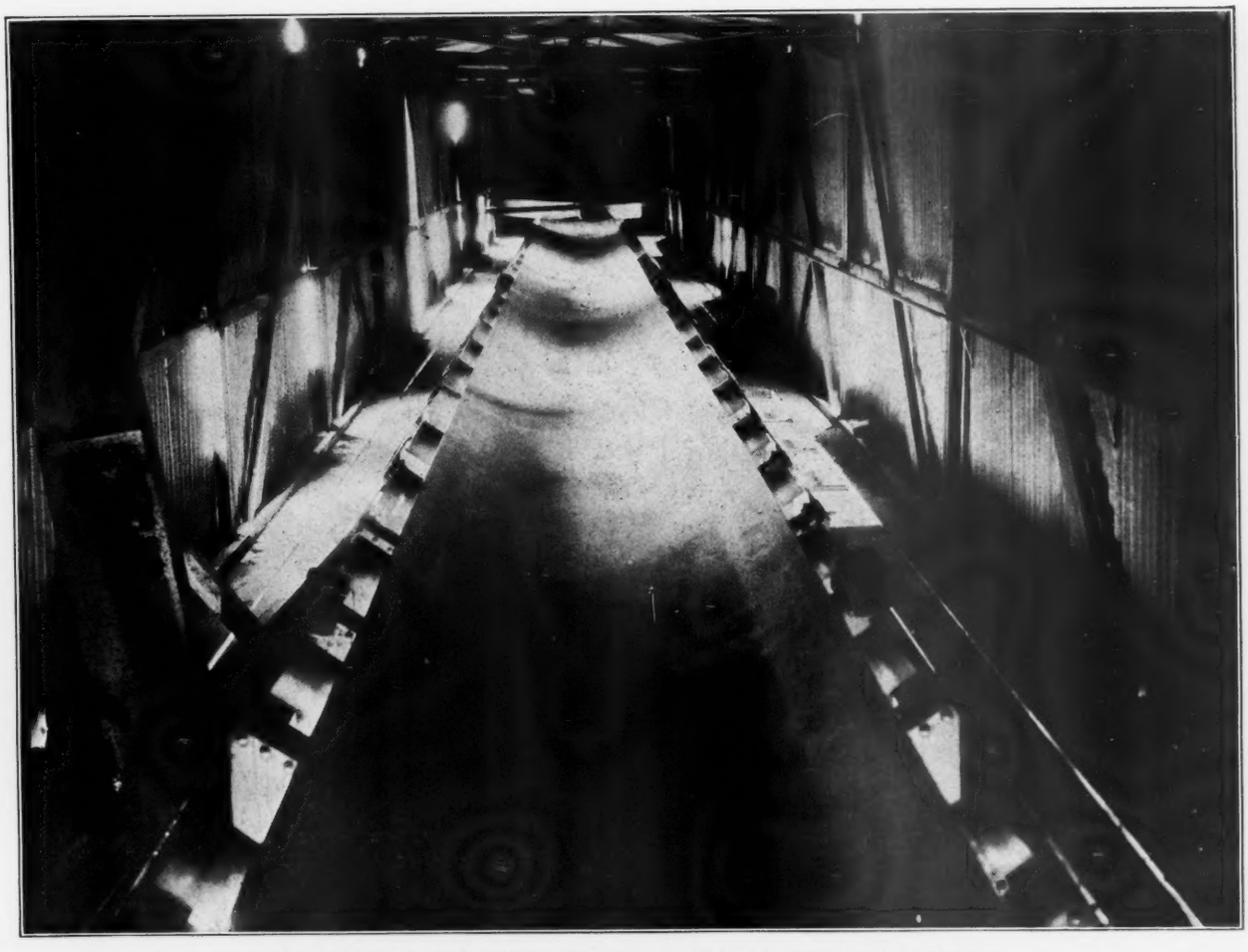
Showing 500 H. P. Synchronous Motors With Clutches

and Mr. Cheeseman, consulting chemist for the company, is said to increase the capacity of the kilns 40 per cent. The system is built up on scientific principles in which a perfect distribution of pulverized coal in a definite velocity of air combined with the correct draft have been determined. About 2800 degrees F. of heat is developed in the kilns but actual calcination takes up much of this heat, allowing gases to pass from the kilns at about 700 degrees F.

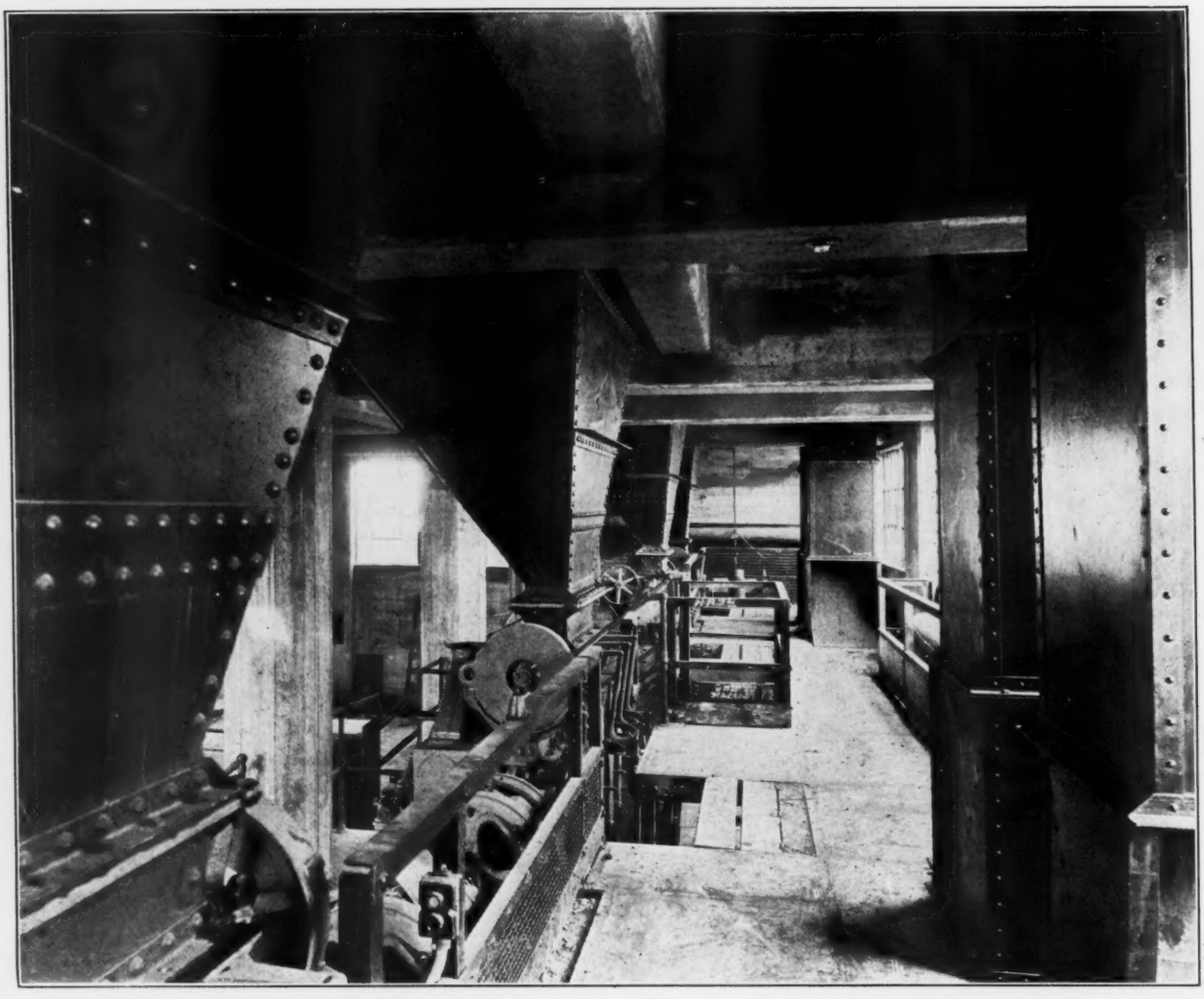
Clinker is discharged from the kiln into a pit where it is picked up by bucket elevators and discharged to the clinker storage. This building is an exact duplicate of the rock storage. A seven-ton Milwaukee electric traveling crane is used to distribute clinker in storage and also to feed compartment tube mill hoppers. It handles coal and gypsum in a similar manner. The building stores 100,000 barrels of clinker, 5,000 tons of coal and 2,000 tons of gypsum. Receiving hoppers for coal, gypsum and clinker are all in one line, thus eliminating any elevating or conveying machinery in this department. Clinker is removed from the bottom of the hoppers by Schaffer automatic weighing poidometers similar to those used on rock in the raw mill. These poidometers feed the clinker into the tube mills at a definite rate.

The finish grinding mills are an exact counterpart of those in the raw grinding department. Three Traylor 3 compartment tube mills discharge cement to a screw conveyor which discharges in a hopper of 200 barrel capacity located in the finishing department at the end of the row of mills. At this point is introduced a radical departure from customary methods of transporting finished cement. The old system usually consisted of a combination of screw conveyors and elevators which have always been notorious for their high first cost, low efficiency and excessive maintenance costs.

To avoid these difficulties the Fuller Kinyon pneumatic system was adopted. This system has proven to be one of the greatest features of the plant, and its flexibility, dustless operation and high efficiency have far surpassed expectations. Cement is not only pumped from the mills and distributed among the storage silos but is also pumped from spouts in the basement of the silos to the packing bins. In this manner the cement is quietly and cleanly conducted through a 5-inch wrought steel pipe to its destination instead of being dragged along by a dusty, clanking screws whose unlubricated bearings and numerous moving parts present a constant hazard to continuous operation, not only of the conveyor but the entire finishing department. Height also presents no terrors for this new system and instead of the old method of



Rock Conveyor Belt Gallery Showing 54 Inch Belt From Boat to Storage



Top View Shows Kiln Supports And Instrument Board in Center Background. Lower View Shows Packing Floor With Three Packing Units

elevation by means of buckets on a chain, the cement is conducted through the pipes to points 100 feet above the ground and distant as far as 400 feet horizontally from the mills. Two pumps are in place under the screw discharge hopper, either of which can be used while the other remains as a spare.

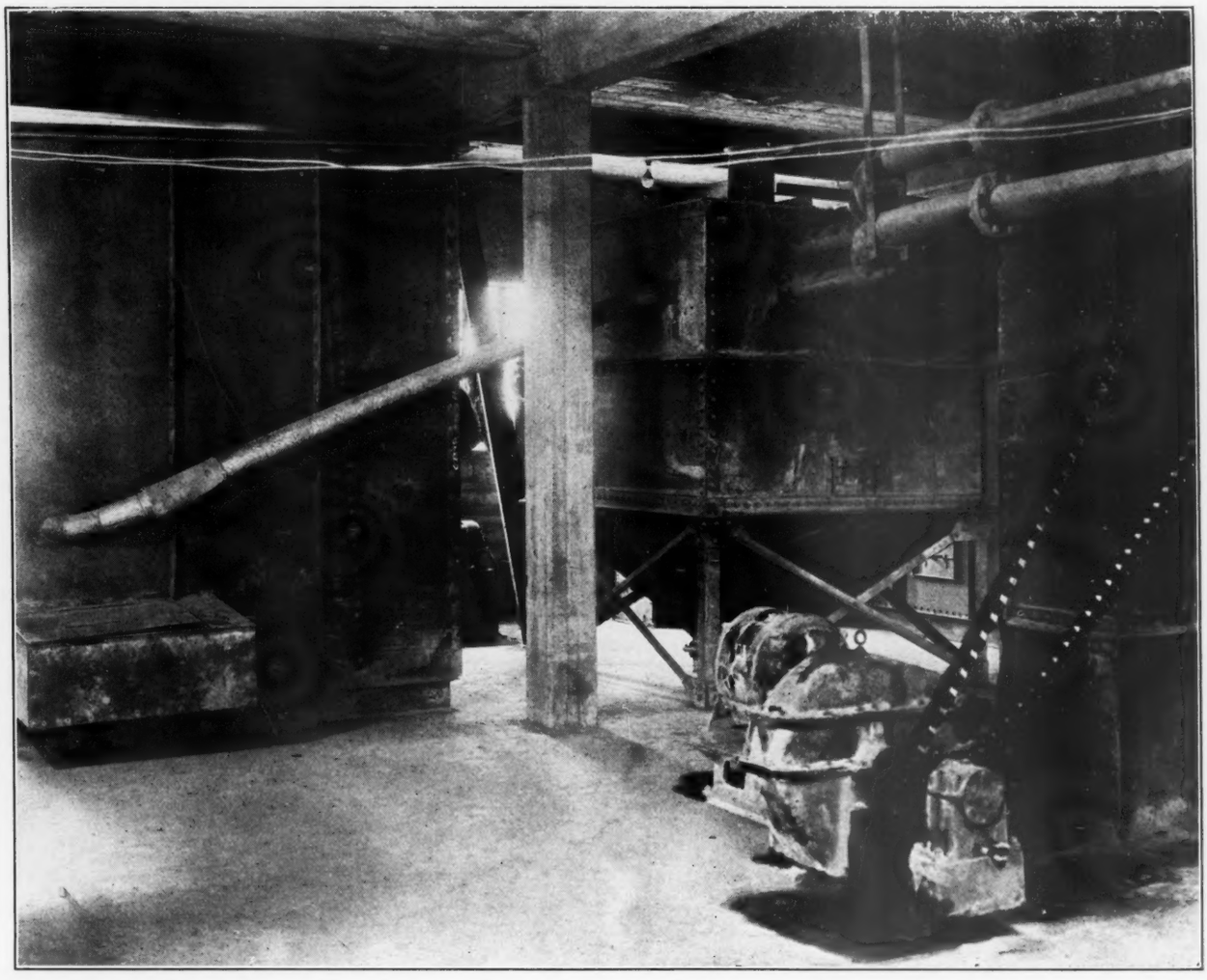
Cement is stored in a battery of 12 silos each 32 feet in diameter and 80 feet high which with adjoining pockets give a capacity of 255,000 barrels. In the basement underneath each row of silos are two narrow gage tracks. Pumps mounted on carriages run on these tracks drawing cement directly from the tanks and delivering through 5-inch pipes directly to the hoppers over the Bates packers. Adjoining the stock house is a five-story reinforced concrete packing house 50 by 68 feet on the ground. This building accomodates four 3-tube Bates packers and is completely equipped with bag cleaner, freight elevator and dust collecting machinery. It is a model of convenience and cleanliness and has been said to be the most complete building of its kind in existence.

Loading tracks are provided on both sides of the packing house, two of the packing machines serving each track. Trucks are loaded directly through the cars. Truck traffic is usually more or less intermittent and this method prevents confusion and avoids the necessity of the men leaving the car in which they are working. The cement storage and packing house were both constructed by the MacDonald Engineering Company.

Coal Department

Coal is dried in a 4 foot 6 inch by 42 foot Fuller Lehigh direct fired dryer. In conjunction with the dryer is a cyclone dust collection system which reclaims all the coal dust and returns it into the firebox. This arrangement not only eliminates dust but furnished fuel for operation of the dryer. The discharge from the dryer is conveyed to three Fuller Lehigh pulverizers where the coal is ground fine enough for kiln feed. The pulverizers discharge to a 6-inch Type C Fuller Kinyon pump which conveys the coal through a pipe line to bins ahead of the kilns. This coal conveying system is a decided success and is very cleanly in operation. The coal being conveyed by compressed air through pipes, none of it can escape as dust.

One feature of the plant is that, although originally laid out for a 3 kiln installation, production



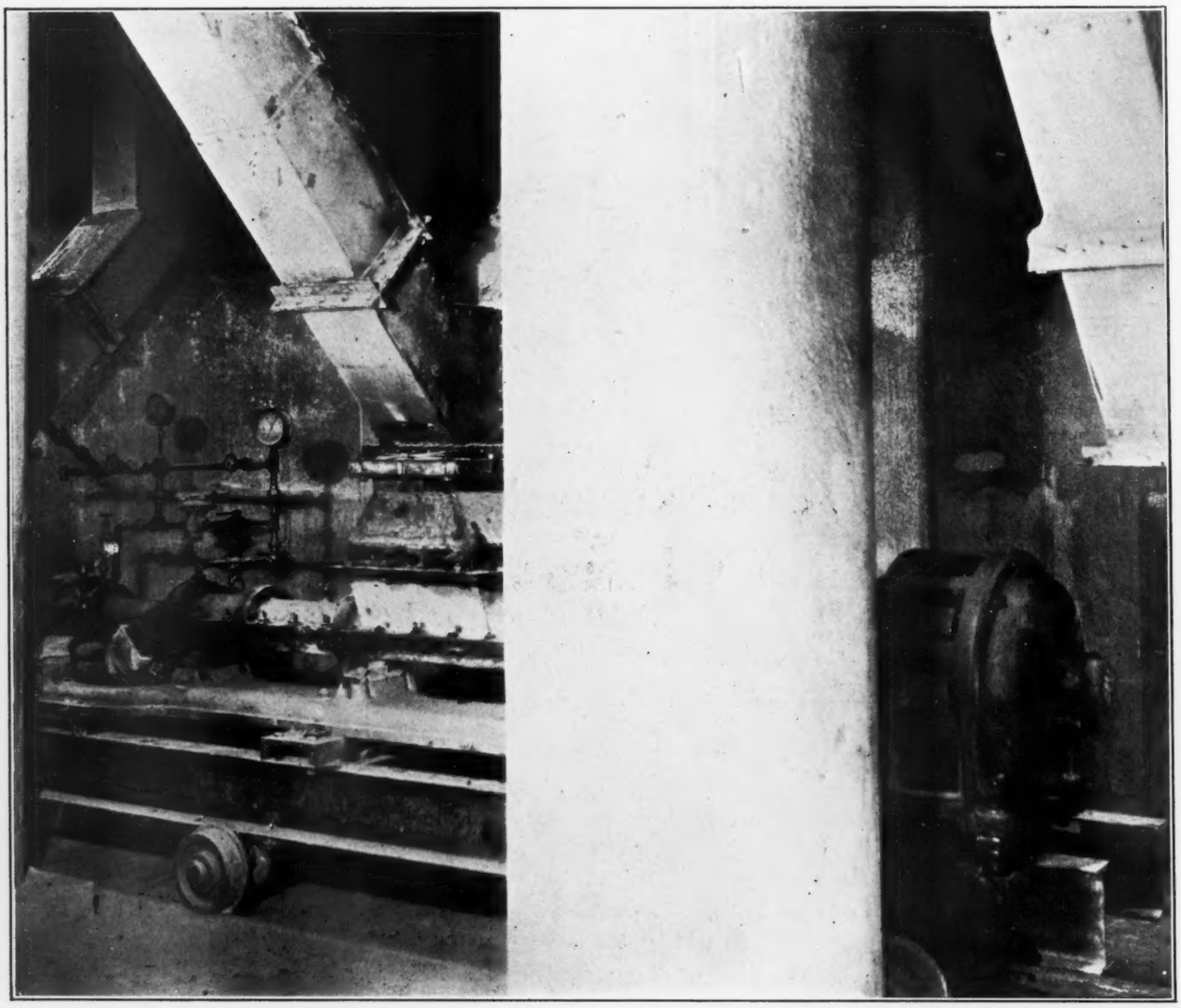
View in Fifth Floor of Pack House Showing Cement Receiving Hopper, Cement Spill Elevator and Dust Collector Unit.

was started immediately upon completion of the first unit and continued uninterrupted throughout the later additions of kiln and grinding units. The plant is now at the stage of two kiln capacity in all departments. Installations of machinery are still being made and it is expected that in the near future that the third kiln will be installed. A special feature in the operation of the plant has been the capacity obtained from both the raw and finish grinding tube mills. Actual production figures of the plant show that the capacity of the wet mill has been at an average of 85.3 barrels per tube mill hour while the finish mill showed 85 barrels per tube mill hour. This coupled with the exceptional capacity of the kilns gives the plant a remarkably high capacity rating.

Stacks 155 feet high are located back of the kilns but before gases are permitted to enter the stack they are passed through a precipitation chamber where they are washed free of all dust. In this manner the neighborhood nuisance common to most plants is avoided. The escape from the stacks is a white vapor or steam which creates a very pleasing appearance. The precipitating chamber and washing system was designed by Mr. Acker.

Power is purchased from the Detroit Edison Company which furnishes primary service to the company's sub-station. Current comes in underground on three independent power services. The bus equipment in the sub-station is so arranged that operation is dependent upon no one line for continuous service. The primary voltage is 4600-v, 60 cycle, 3 phrase which is stepped down through 3 banks of three 200 Kva Westinghouse transformers each to 440 volts. The transformers are located in three central points of distribution in the mill thus eliminating line drop and heavy feeder transmission. The 500 synchronous motors are operated on 4600v. Direct current for their operation is furnished by two 125 h.p. induction motor driven generator sets.

All equipment throughout the mill is operated by individual motors and wherever reduction of speed is necessary the required ratio is obtained by the use of speed reducers or silent chain drives. On



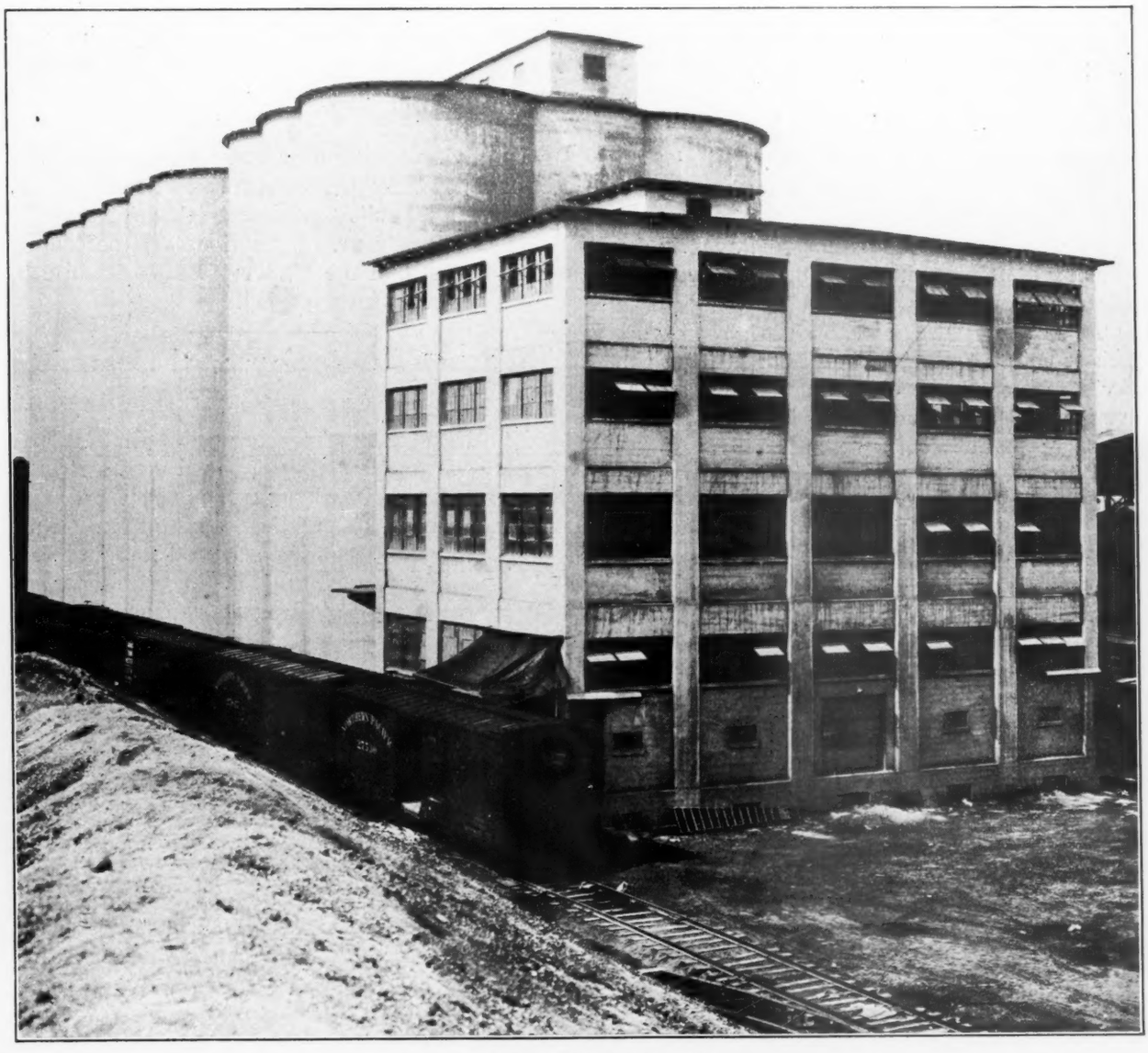
Cement Storage Basement Showing Pump Mounted on Carriage

the heavier drives the Falk herringbone gear reducers are employed while the lighter drives are equipped with Cleveland worm gear reducers. Where a comparatively low reduction ratio is desired the Link-Belt silent chain drive is used. The induction motors range from 3 h.p. to 150 h.p. with speeds of 870 and 1160 r.p.m. Wherever practical and the power requirements are similar, uniform types and sizes of motors have been used on the different operations. This policy eliminates additional cost of spare motors besides giving interchangeability from one service to another. All squirrel cage motor equipment is equipped from one service to another. All squirrel cage motor equipment is equipped with Westinghouse remote controlled starters. As a safety precaution in each department starters for motors are arranged in a room by themselves. The push button which starts and stops each machine is so located that the operator has a full view of all moving parts at the time of starting. The total connected load in the plant is 4500 h.p.

Laboratory Facilities

A substantial two-story brick building 30 by 60 feet located in the court between the machine shop and the finishing mill was selected as the laboratory. It has been very completely equipped with both chemical and physical testing equipment and a close check on the control of operations in the plant is kept at all times. The latest addition to the equipment is a hydraulic compression machine for testing the strength of concrete cylinders. The operation of kilns, grinding machines and other important operations are all recorded by electrical devices at a central point in the laboratory. Thus lost time in any department is immediately apparent and its cause checked up. In this manner a complete history of the operation of each department is kept and becomes a matter of permanent record.

The officers of the New Egyptian Portland Cement Company are as follows: M. D. Smith, president and general manager; E. R. Sullivan, vice



Pack House With Storage Silos

president and sales manager; C. A. Bray, secretary and treasurer; J. A. Acker, consulting engineer and ass't general manager; R. D. Cheeseman, consulting chemist; A. A. Oesterle, superintendent; J. L. Bateman, chief chemist and E. F. Rowe, chief electrician.

Course of Industry Goes Westward

In January, 1908, the center of industry in the United States was on the northern boundary of Indiana, about 110 miles east of Chicago. In January, 1918, it was still on the northern boundary of Indiana but had moved about 50 miles nearer to Chicago. In January, 1926, it had moved 25 miles to the southwest of its position in 1918 and was about 50 miles southeast of Chicago. The total movement in the 18 years from 1908 to 1926 was about 75 miles in a west by south direction. This slow movement of the center of industry during a period when the capacity of prime movers in central stations and manufacturing plants increased about 140 per cent indicates that industrial development in the United States is preceeding at about the same rate in all sections but a trifle more rapidly in the western and southern parts of the country.

These determinations of the center of industry, which have been made by the Geological Survey, Department of the Interior, are based on the capacity of steam engines, steam turbines, water wheels, and internal-combustion engines installed in manufacturing plants and in public-utility power plants. Twice the weight is given to the power equipment in public-utility power plants, as it is used twice as much as power equipment in manufacturing plants. Previous determinations of the center of industry have been based on the installed capacity of prime movers in manufacturing plants only. It is believed that more representative results are obtained by using the capacity of power equipment in both manufacturing and public-utility plants.

None Compare With Pit and Quarry

C. A. Starkweather, president and treasurer, Lannon Quarries Corporation, writes, "Since you have increased the size of your publication, the writer has taken a great deal of pleasure in reading some of the numerous articles and in nearly every one, some item is found that has suggested a means whereby we ourselves, have been able to improve our operations at Lannon. The numerous pictures of other quarries we believe, is one of the big factors in making your new policy more interesting to the reader.

"There are other magazines published in the interest of stone quarries and sand pits but none of them compare with yours in furnishing reading material that is of interest from the manager down to the straw boss."

Winter Building Is Tonic to Trade

Building and allied trades cease to suffer from winter slump as the popular winter building bogey is routed, says George E. Warren, assistant general manager of the Portland Cement Association. "Wise builders are plannin now for construction straight through the cold weather season. Use of twelve months in the year instead of eight or nine eliminates the loss from seasonal depression that has been so costly to industry."

Construction engineers agree that building in winter is not only practical but highly desirable from the owner's point of view as well as the worker's. Structurally, building operations can go on through cold weather without any risk if ordinary precautions are taken, it is stated. Employment during the winter months means that the economic stability of business will be maintained, Warren points out. Not only men employed on construction work but those supplying building materials and engaged in the many lines touched by construction are able to retain their standards of living.

"Maintenance of these standards, and with them buying powers is reflected automatically in the marts of trade. Healthy activity in a five billion dollar industry is stimulating to all others." Building statistics for the past few years reveal that more and more buildings are being financed and built during the winter months. In sixteen cities surveyed payrolls and material purchases have mounted each year. Indications are, according to contractors, that the winter of 1927-28 will eclipse any previous winter period.

Highway Research Board Committees Meeting to Prepare Annual Program

For the purpose of preparing the program of the Seventh Annual Meeting of the Highway Research Board to be held December 1 and 2, 1927, the six research committees of that organization are planning to meet either at the National Research Council Building in Washington, D. C., or at other cities designated by the committee chairmen, early in September, as was anounced by Charles M. Upham, director of the board.

These research committees are those on, The Economic Theory of Highway Improvement, Structural Design of Roads, Character and Use of Road Materials, Highway Traffic Analysis, Highway Finance, and Highway Maintenance.

At these meetings members will make reports on their assignments and from these the chairmen will prepare their respective reports for the Annual Meeting of the Board in December. It is planned that the program for the December meeting will be a resume of completed research, researches believed to be urgently needed in particular fields, and researches on which definite conclusions have been reached during the past year.

HOW THE LYNN SAND AND STONE COMPANY UTILIZES ORIGINAL IDEAS OF DESIGN

By F. A. Westbrook

LOCATED at Swampscott, Massachusetts, is a comparatively new operation owned by the Lynn Sand and Stone Company, which is equipped with new machinery, some of it of new design. At the present time the production is from 1,200 to 1,500 yards per day but later on, when the quarry has been enlarged so that it may be worked in two benches simultaneously, this will be very materially increased. The principal owner and president of this company is Mr. J. H. Cooke, of Hartford, Connecticut, and the readers of Pit and Quarry will remember the article in the January 2, 1927, issue telling about Mr. Cooke's other operation at Hartford, known as the Hartford Sand and Stone Company, and the very interesting things that he did there. He has done the same interesting things at Swampscott and more besides as a result of experience and because of variations in local conditions. These points of interest can best be noted as we go through the plant.

There is considerable variation in the height of the breast, it being as little as 20 feet at the low point and as much as 75 at the highest, but most of it is high enough to use well drills. At present one Keystone drill is in operation and two Clipper drills and another of the latter will be in service very shortly. These are electrically operated. As the breast is pushed back its height will become more uniform. One Ingersoll-Rand X-71 drill is used for drifting in the low places where it does not pay to use the well drills. In general the well-drill holes are placed 25 feet back, 20 feet apart and are carried 6 feet below the floor. The explosive is 60 per cent gelatine dynamite.

Fine Concrete Office Building

There are also four Ingersoll-Rand jack hammers for breaking up the large pieces although, as shown in one of the illustrations, very large pieces of rock are taken to the primary crusher.

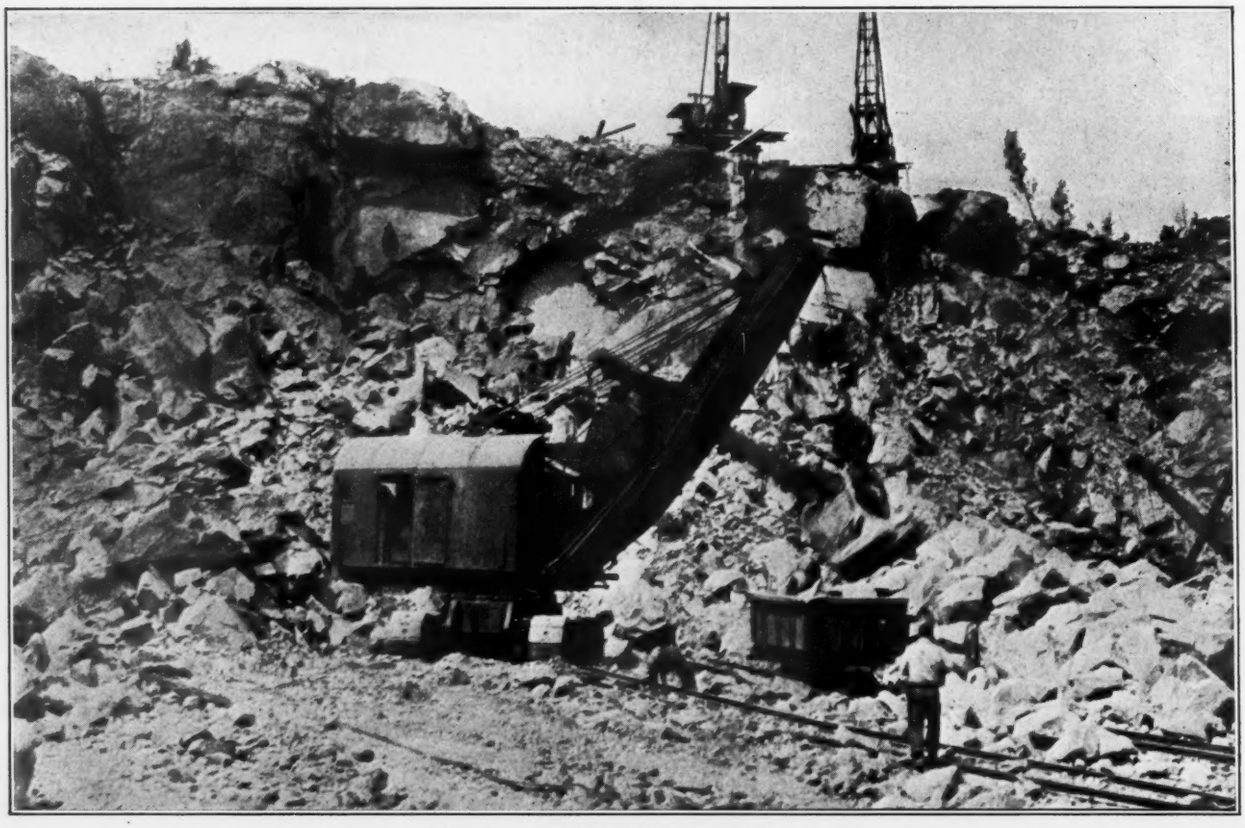
Stone is picked up at the face by two Marion electric shovels. One of these is a recent design, in fact the second of its kind ever made, known as Type 490. It has a 2¼ yard dipper and is of

Large Rock Being Picked Up by Second Shovel

Well Drills at Top of Quarry

very rugged construction. The other shovel is a Marion Type 37 with 1¾ yard dipper.

While on the subject of electric shovels it will be interesting to take note of the kind of flexible insulated wires or cables used to serve them. Single conductor cables are used rather than three conductor cables because as Mr. Cooke says, it is much easier to locate and remedy trouble when the three conductors are lying separately on the ground than if they are all enclosed in a common sheathing. Of course the mechanical wear and tear to which such cables are subjected is extremely severe so that trouble is bound to occur more or less frequently. Of course it is desirable to reduce these occurances to a minimum and in order to do so it is necessary to select a cable with an outside covering which is as resistant to abrasion and cutting as possible. The type selected by Mr. Cooke is known as "rubber sheathed" cord, or cable, and while it has the usual flexible stranded copper conductor, the outside covering consists of an especially thick sheathing of rubber instead of a tarred braid. The idea of this is that the rubber, being compressible and resilient, will more successfully withstand the abrasion and cutting actions to which it is subjected than the old-fashioned braided coverings. It actually works out that way in practice and several of the insulated wire manufacturers have placed this type of flexible insulated conductor on the market. It is coming into wider and wider use wherever portable electrical tools are employed. Judging from the dilapidated braided conductors which are sometimes seen it would be worth while for all operators in the non-metallic mineral in-



New Type Electric Shovel at Work

dustry to look into this matter. Doubtless a good deal of lost time and annoyance is waiting to be saved in this way.

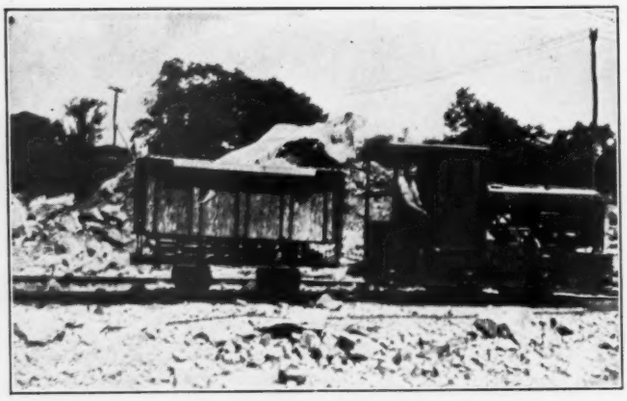
The way in which these flexible conductors are connected to the supply line is simplicity itself. Wires of the usual kind are run out on poles as near to the point of utilization as practicable. They are dead ended on a cross arm and the ends allowed to hang down. These are attached to the flexible conductors by means of copper connectors. The flexibles are attached to a lower cross-arm and then drop to the ground. As the utilizing machinery moves away a pole may be added to the line as circumstances permit so that the amount of flexible cable on the ground, and subject to excessive wear, may be as short as possible.

This digression on the flexible cables seems rather long but it also seems justifiable in view of the increasing use of movable or portable electrical machinery, none of which can give any better service than its cable makes possible. Mr. Cooke's son and Mr. Manchester the superintendent, are responsible for a great many of the special features of this operation, others of which will be discussed later.

The stone picked up by the shovels is placed in side dump quarry cars made by the organization. They are hauled by two Plymouth gasoline locomotives, a 5 ton and a 7½ ton, one to each shovel. At the primary crusher they are tipped by means of a 5 ton Euclid electric hoist hung from the beam of the 30 ton Armington crane extending over all of the crushers and used for making repairs. It

Secondary Crushers and Crane Over Them

Drifter Drill in Operation



Large Piece of Rock Being Taken To Primary Crusher

is at this point where the advantage of the automatic side door designed by Mr. Cooke becomes evident. It is held in place by a wire rope when the car is horizontal but when tipped this rope, which passes over pulleys, is given sufficient slack to permit it to swing outward. As the car comes back into position the wire rope closes the door and holds it shut. The accompanying diagram shows how the device works.

The primary crusher is a 60x48 Traylor. It is provided with a manganese steel hopper (American Frog and Swith Manufacturing Company) designed by Mr. Cooke, so that the stone strikes the sides rather than the front apron, which it is felt is less likely to create a jam. From the primary crusher the stone is taken by one of Mr. Cooke's steel link chain elevators, described in detail in the previous issue already referred to, to a hopper of 100 ton capacity. This feeds by gravity into a number 12 Allis-Chambers (secondary) gyratory crusher. From this the material is elevated and discharged into two scalping screens, also of a design by Mr. Cooke described in the issue of January 2, 1927. The tailings from these descend respectively to two number 6 C type Allis-Chalmers gyratory crushers and then go back to the two scalping screens by the elevator from the secondary number 12 crusher.

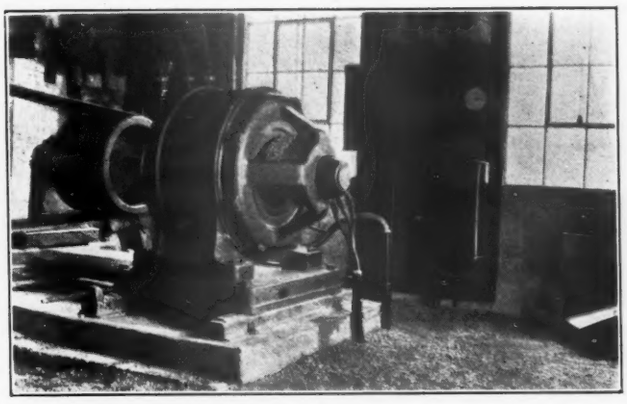
The company is using a gyratory crusher of its own design, built for it by the Allis-Chalmers Manufacturing Company. These crushers are a compromise between the so-called "short shaft machine" and the so-called "long shaft machine." It is the belief of Mr. Cooke and his associates that a gyratory crusher for crushing hard stone should have the eccentric located below the diaphragm of the machine, thereby gaining a leverage over the crushing point. These machines also have a very large gear which further adds to the leverage. The counter-shaft of the machines run in babbitt sleeve bearings, with no bolts or adjustments. When these sleeves-bearings are worn out they are re-they are removed and replaced by new ones which are made in a mould furnishd with the machine. There is, in addition, a dust seal under the head to prevent any dust from entering. In fact the machine is supplied with about 20 gallons of oil circulated by a pump through ¾ inch pipe which carries it through a coil placed in a barrel of water for cooling. This pump is located apart from the crusher and is driven by a belt from the counter-

Dumping Car into Primary Crusher. Note Cables Which Automatically Close the Side Door When Car Returns to Upright Position

shaft. It has been found sufficient to change the oil every two months. No wear is noticeable on the eccentric when this is done, and it is anticipated that the babbitting will last about two years.

The capacity of these crushers is about 50 per cent greater than with other gyratory crushers of the same size because the strong construction permits of higher operating speed. The number 6 crushers are run at 600 r.p.m and the number 12 at 500 r.p.m. Due to the fact that the eccentric shows no wear the machine is always kept up to its maximum throw.

From the scalping screens on, and including them, there are two separate but similar units to the end. Material passing through the two scalping screens is carried by separate elevators to two sizing screens placed at right angles to each other and at different levels. Each has a jacket. Each screen and jacket sorts out just one size, this being the best method for handling the large quantities of material which come through. The way the sizes are sorted is, then, as follows: The largest size comes from the scalping screen, the first sizing screen has 1½ inch holes so that the tailings are determined by the scalping screen holes. The tailings from the first jacket, which has 1 inch holes, give the 1½ inch size. Stone passing through the 1 inch holes of the first packet drops into the second screen, at right angles to the first and at a lower level. This has ⅝ inch holes and the talings give the ¾ inch size. The second jacket has 4½ wire mesh so that the tailings from this are the ½ inch and what passes through is dust or sand.

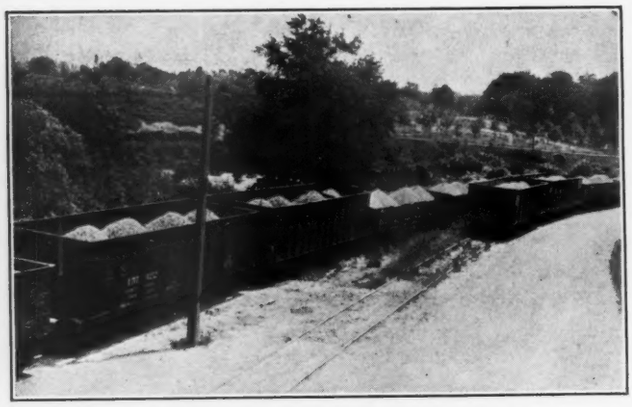


Motor for Driving Primary Crusher

An interesting feature about the arrangement of the plant is that the crushers are grouped close enough together so that they can all be served by the Armington crane and by a derrick which shows in some of the photographs. This is especially useful in moving blocks of stone which sometimes jam in the primary crusher. In fact this derrick covers pretty much the whole plant where such service might be required. It is equipped with a Lidgerwood hoist operated by air. It is only used occasionally and as air is always on hand it seemed the most economical under the circumstances. It is one of those details of plant design which means so much in successful and economical operation.

There are some other details of this kind which are very practical. One of these is that Mr. Cooke makes it a practice to place his motors in separate buildings or in rooms by themselves where they will be away from the dust. Thus the 200 h.p. type

Quarry Car About to be Dumped into the Primary Crusher



Loaded Freight Cars Ready for Shipment

Storage Bins from Which Freight Cars and Trucks Are Loaded

CW Westinghouse, three bearing, motor which drives the primary crusher and elevator is well isolated in a separate building. The 300 h.p. Crocker-Wheeler motor which drives the gyratory crushers and the screening plant is in a room of its own and the Ingersoll-Rand compressor with its 125 h.p. Westinghouse motor is in a building by itself.

Lubrication has been given the most careful and intelligent attention. Half inch pipes connect every bearing with some convenient point for oiling. Some of these pipes are 10 feet long and serve bearings which are so difficult to reach directly that they would probably otherwise never receive proper attention. The oiling ends of these pipes are arranged in groups so that it is the easiest thing in the world to tend them. Not only does this insure proper lubrication but Mr. Cooke feels that the oil feeds in to the bearing gradually from these pipes in a way which is most desirable.

Another thing of importance is that the plant is kept clean. As Mr. Cooke expresses it, "You can get around the place without overalls." The storage bins are of first class concrete construction as shown in the illustrations. Two thirds of the shipments are by rail and as the volume of production is increasing it has been found necessary to extend the siding in order to avoid two car shifts per day. This is now in progress. About one-third of the output is shipped by truck, but mostly in contractors' vehicles. Only two Mack trucks, equipped with Wood bydraulic hoists, are owned by the company.

This plant represents a well balanced operation which is being conducted by men with long experience in the business.

Elevator Feeding from Primary Crusher into Hopper Above Secondary Crusher. Note Derrick

RAPID DETERMINATION OF LIME IN CEMENT LABORATORIES

ONE of the most important of all the analytical determinations that are carried out in the laboratories of the cement companies, lime burning plants and the like on limestones, slag, raw cement mixtures, clinker and finished cements is to establish the percentage of lime contained in these products. The standard method of determining the lime in cements, etc., as carried out in a regular routine rock analysis, is accurate, to be sure, but it is too slow for practical purposes. Many attempts have been made to develop methods which will allow of the rapid and accurate determination of lime. Some of these have been very satisfactory and others not. In the following article there is given a brief description of all the various rapid lime determination methods that have been developed within recent years and that are of value. Sufficient detail is given so that the reader can employ the method himself in the laboratory and additional information can be obtained from the references. This article is of great value to the chemist in the plant laboratory and his attention is particularly called to it.

The first method to be considered is the tartaric acid method. There are two forms of this method, the first including the precipitation of the silica, developed by Kuehl and Klasser and described in detail in Zement, 1926, pages 385ff, without the precipitation of the silica.

We will first consider the first form of the method. It is known that the addition of tartaric acid prevents the precipitation of iron, alumina and manganese when ammonia is added. The lime can then be completely precipitated from this tartaric acid and ammonia containing solution, the lime being determined by titration under the following conditions.

Half a gram of the sample is weighed out and placed in a 300 cubic centimeter beaker with fifteen cubic centimeters of hydrochloric acid with the addition of a few drops of nitric acid or bromine water, added for the purpose of converting ferrous iron into ferric iron. After solution, the mixture is evaporated to dryness on the water bath. After ten minutes' heating to approximately 130 degrees C, the solids are taken up with twelve cubic centimeters of dilute hydrochloric acid, diluted with thirty cubic centimeters of water and filtered through a rapid filter into a 500 cubic centimeter beaker, and the precipitate on the filter is washed with hot, chlorine-free water.

The filtrate is then diluted to a volume of 400 cubic centimeters, ten cubic centimeters of a ten percent solution of tartaric acid (one gram of tartaric acid) are added and the solution is made alkaline with ammonia. The solution must remain perfectly clear. It is then heated up to the boiling point and the lime is precipitated by the addition of thirty cubic centimeters of a boiling hot ten percent solution of ammonium oxalate (three grams of ammonium oxalate).

After boiling for a short time, the precipitate, which is crystalline when the precipitation has been properly carried out, is allowed to settle for five minutes and is filtered hot. The precipitate is transferred to the filter paper and the beaker as well as the filter are washed four times with hot, ammonium oxalate containing water (two grams of ammonium oxalate per liter of water). Then both the beaker and the filter are again washed four times with hot water. In washing the beaker care is taken to see that the water runs down the sides of the beaker all along the upper edge and also that the edges of the filter funnel are also washed down.

The precipitate and the filter paper are then removed and placed in a beaker. Then 400 cubic centimeters of water, previously heated to a temperature of 90 degrees C, are added as well as twenty cubic centimeters of dilute sulphuric acid (one to three). Then while the precipitate is being thoroughly agitated, the mixture is titrated with a standard solution of potassium permanganate. After a few drops of the permanganate are added, the liquid turns red, and before more permanganate is added, the red color is first allowed to disappear, indicating that the reaction between the permanganate and the oxalate has set in.

In connection with this method it must be mentioned that the information that is given in the literature to the effect that the presence of large amounts of ammonium salts disturbs the precipitation of the lime as oxalate is not correct. When a portion of the lime remains unprecipitated under these conditions it is only due to the fact that the precipitation has not been properly carried out.

The precipitation of the solution must be effected with the aid of a boiling hot solution of ammonium oxalate which is added to the boiling hot solution that is being precipitated. When this operation is properly carried out, then the calcium oxalate will have the aforedescribed constant composition, and can be titrated with the aid of a standard solution of potassium permanganate, irrespective of whether large or small quantities of ammonium salts are present. It is safe to say that insufficient attention has been given to this detail in the method. If the precipitation is carried out with solutions that are hot enough, or if the oxalate is added in the solid form to the boiling hot ammoniacal solu-

tion, then a precipitate of varying composition will be obtained and inconsistent results are secured.

The method requires approximately one hour for completion. The results which are shown in the following tabulation number I indicate that the accuracy of the method is all that may be desired, for it agrees very well with the double ammonia precipitation method. The differences amount to scarcely one-tenth of one percent in most cases, and approximate 0.2 of a percent only in rare cases. The results agree very well with gravimetric methods in which the precipitate is washed only with ammonium oxlate solution. It therefore appears that the washing out of the ammonium oxalate contained in the precipitated calcium oxalate in accordance with the method that has been described above has no detrimental action on the precipitate.

TABULATION NO. I.

Character of material	Lime determined after double ammonia precipitation	Tartaric acid method with separation of silica
Slag 1	51.15	51.15
Slag 2	50.25	50.30
Slag 3	50.15	49.98
Slag 4	49.88	49.88
Slag 5	51.00	50.80
Raw cement mixture 1	50.80	50.96
Raw cement mixture 2	49.66	49.66
Raw cement mixture 3	50.19	50.19
Raw cement mixture 4	51.21	51.21
Raw cement mixture 5	49.28	49.28
Clinker 1	68.65	68.74
Clinker 2	69.46	69.46
Cement	53.64	53.74

The second form of the method does not involve the separation of silica. The method carried out under these conditions will give as good results as when the silica is removed. In this case half a gram of the sample is weighed out into a 500 cubic centimeter beaker and again dissolved in fifteen cubic centimeters of dilute hydrochloric acid with the addition of a little nitric acid or bromine water, the mixture being heated for about ten minutes. The water which is evaporated during the dissolving process is replaced and particles of the sample which form lumps are broken up with the aid of a glass rod. Then the solution is diluted to a volume of 400 cubic centimeters and ten grams of a tartaric acid solution are added. The boiling solution is then made alkaline with ammonia and precipitated, filtered, and titrated as in the first method.

The hydrochloric acid solution, after being diluted with water, is generally found to be only slightly turbid, for the greatest portion of the silica is present in the soluble form. On the addition of ammonia, however, the greater part of the silica is precipitated and a flocculent mass is obtained, which is carried along with the precipitate when the lime is precipitated with the aid of the oxalate solution. The filtration of this silica-containing calcium oxalate offers no difficulties of any sort. The process required about forty minutes to obtain a result. The accuracy of the method is evident from the results given in tabulation number II. Experiments have shown that the most favorable results are obtained with the addition of one gram of tartaric acid, for the addition of more tartaric acid has a rather detrimental effect.

TABULATION NO. II.

Character of material	Lime determined after double ammonia precipitation	Tartaric acid method without separation of silica
Slag 1	49.98	49.98
Slag 2	49.88	49.98
Raw cement mixture	49.28	49.38
Clinker 1	68.74	68.64
Clinker 2	69.46	69.66

The next method that must be considered is the back titration method that was developed by Balthasar (see Chemiker Zeitung, 1909, pages 646ff). The principle of this method, which has for its purpose the determination of lime in the presence of silica, consists in adding an excess of standardized oxalic acid to the ammoniacal solution, and then an aliquot portion of the solution is taken and the excess oxalic acid present therein is titrated with the aid of a standard solution of potassium permanganate. The oxalic acid that has combined with the lime can then be calculated and the lime content of the sample determined. The solution is first filtered before the aliquot portion is taken.

Thus 0.7 of a gram of the sample is weighed out and placed in a small beaker (150 cubic centimeter size) or in a porcelain evaporating dish and treated with a little concentrated hydrochloric acid while being warmed. The decomposition of the sample is assisted by pressing out the small lumps of the sample with the aid of a glass rod. The uniform, syrupy mass is then removed from the dish into an Erlenmeyer flask of approximately 350 cubic centimeters capacity, which carries a graduated mark on its neck. The exact volume contained by this flask is determined once for always and this value is used in the analysis. Flasks which have narrow necks are most suited for this purpose.

The 50 to 100 centimeters of liquor in the flask is boiled for two minutes in order to drive out all the carbon dioxide contained in the flask. Then about fifty cubic centimeters of a precipitating solution are added. This solution is prepared by dissolving twenty grams of sal ammoniac in one hundred cubic centimeters of acetic acid and then making up to a liter volume by the addition of concentrated ammonia. After the mixture of this solution and the dissolved sample in the Erlenmeyer flask has been boiled for a short time, then without stopping the boiling of the latter, fifty cubic centimeters of a half normal solution of oxalic acid are added through a pipette, the flask is shaken and then it is quickly cooled in running water down to

the room temperature. Then the volume of the flask is brought up to the mark by the addition of distilled water and the mixture is thoroughly agitated for several minutes by means of a glass rod and then the solution is filtered through a dry filter paper.

The first portions of the filtrate are mostly turbid and are discarded. Just as soon as more than fifty cubic centimeters of the clear filtrate are obtained, then exactly fifty cubic centimeters are pipetted out of the clear filtrate, mixed with five cubic centimeters of concentrated sulphuric acid and a few cubic centimeters of manganese sulphate solution (manganous salt), and then the solution is heated up to a temperature of 80 to 90 degrees C. and titrated with the aid of tenth normal solution of potassium permanganate solution. The cubic centimeters of permanganate solution that are used in this titration, are multiplied by a constant and subtracted from 100, and this then gives the content of lime in the sample without further calculation. The constants used are obtained by multiplying the contents of the flask by 0.008. If the contents of the flask are k cubic centimeters and the consumption of potassium permanganate solution was a cubic centimeter under the above analytical conditions, then the lime content is found from the following equation: $CaO = (100 - 0.008 \times k \times a)\%$.

When a tenth normal solution of potassium permanganate is not available for this purpose, then the number of cubic centimeters consumed (that is a cubic centimeters) is increased by another factor which is obtained from the normality of the used potassium permanganate solution in terms of the tenth normal solution. It is claimed that the percentage of lime in the sample can be determined by this method within a period of thirty to forty minutes, and the results obtained are very accurate. It has also been recommended in analyzing such products as quick lime, lime ash, soils, and the like that larger samples, up to five grams, be used and placed in a five hundred cubic centimeter standardized flask and dissolved in concentrated hydrochloric acid on boiling. After the dissolved mass has been filled up to the mark, it is shaken thoroughly, filtered through a dry filter and a portion of the sample amounting to fifty cubic centimeters and corresponding to half a gram of the sample, is taken and then treated in the usual manner.

The Ammonium Chloride Method

In accordance with the interesting method which was developed by Desgraz (see Giesereizeitung, 1922, number 49), the lime, and the magnesia as a separate item from the lime, can be determined titrimetrically without the use of acids. This method depends on the fact that the oxides of lime and magnesia are converted into the chlorides by treatment with a concentrated solution of ammonium chloride, while the silica and the sesquioxides, that is alumina and iron, in the sample are not touched. It is then necessary to convert the lime, combined with the carbon dioxide, and the magnesia, by ignition into the oxides. The analytical method is as follows:

The sample is first pulverized and then dried at a temperature of 110 degrees C, and one gram is weighed out in a tared dish or rather small evaporating dish or crucible and heated in a muffle at a temperature of 930 to 950 degrees C until it attains constant weight. The loss on ignition is determined in this manner.

The ignited residue is then carefully wetted with a few drops of water, and after the sample has been slaked it is removed into a beaker of 150 cubic centimeters and then approximately thirty cubic centimeters of a concentrated solution of ammonium chloride are poured over the sample. If particles of the ignited residue still remain adhering to the sides of the crucible or evaporating dish, then the crucible is heated after a few cubic centimeters of ammonium chloride solution are first added, until all of the adhering particles are dissolved and this solution is united with that in the beaker. The contents of the latter are then boiled until the ammonia odor disappears. This results in the oxides of calcium and magnesium, resulting from the ignition, being converted into the chlorides and dissolved, while the other ingredients remain undecomposed.

The water which is removed by evaporation during the boiling process must be replaced, in order to prevent the magnesium chloride that is formed with the evolution of hydrochloric acid at too high concentrations, which then attacks and dissolves the other ingredients, from being decomposed.

The light reddish brown to dark brown residue, which is mostly in the flocculent condition, is filtered. This residue contains silica, iron oxide, aluminum oxide, and other ingredients. It is washed with hot water and weighed. It can then be used for the determination of the aforementioned ingredients.

The water-white filtrate is collected in a measuring flask, diluted up to a volume of five hundred cubic centimeters and then used for the determination of calcium and magnesium oxides.

In determining the lime content, one hundred cubic centimeters of the solution are pipetted off (equivalent to 0.2 gram) and precipitated at the boiling point with the addition of a boiling hot solution of ammonium oxalate (about thirty cubic centimeters of the one to ten solution), the lime being deposited in the form of calcium oxalate.

The granular precipitate is then allowed to stand for half an hour, but it may also be filtered at once, and after standing, it is filtered, the precipitate is

washed free from chlorine. Both the filter paper and the precipitate are put back into the well washed-out precipitating beaker, approximately one hundred cubic centimeters of hot water are added and ten cubic centimeters of dilute sulphuric acid of 1.14 specific gravity, and the precipitate is titrated after dissolving it at a temperature of 70 degrees C, the titration being accomplished with the aid of a potassium permanganate solution, which has been standardized against iron, the end-point being considered the retention of a pink color for a few moments. The standard of the solution as compared to lime is one half that based on iron.

When the titration is made rapidly, then the presence of the filter paper (organic matter) in the mixture has no detrimental effect on the results.

The magnesia can then be precipitated as magnesium ammonium phosphate in the filtrate. Time is saved, however, when the filtrate from the ammonium chloride treatment is used for the determination of the magnesia and the magnesia is then determined in the presence of the precipitated lime in accordance with the method that is used in the determination of the total phosphoric acid in Thomas slag.

One hundred cubic centimeters of the original chloride solution are pipetted off and placed in a beaker of three hundred cubic centimeters capacity and mixed with ten cubic centimeters of a ten percent solution of citric acid, fifty cubic centimeters of an ammonium phosphate solution (fifty grams to the liter) and then the mixture is vigorously agitated. It is even more advisable to effect the precipitation at a temperature of approximately 80 degrees C and to cool the beaker immediately with vigorous agitation of its contents by placing it in a current of running water.

This results in the precipitate of ammonium magnesium phosphate being formed in the granular condition at once, and it then will quickly settle to the bottom of the beaker, so that it can be filtered after a half hour has elapsed. It is most advantageous to filter through a Gooch crucible. The precipitate is washed with a two percent solution of ammonia until the chloride reaction disappears. Then the precipitate is ignited and weighed as magnesium pyrophosphate with 36.24 percent of magnesia.

If it is desired to filter the solution through filter paper, then after the precipitate has been washed on the filter a little solid ammonium nitrate is added which aids the ignition of the precipitate and materially accelerates the burning off of the organic matter so that a white mass is soon obtained.

The solution of the mass after ignition with ammonium chloride permits the determination of quantity of magnesium and calcium, present as carbonates, and also when manganese-containing substances are being examined, without the necessity of using the acetate method. This avoids the need of working with acids, saves time and reagents. The compounds that are present not in the form of calcium and magnesium carbonates can be determined in the residue obtained from the ammonium chloride treatment, as they are not decomposed, up to zinc. The zinc content of the mineral can be determined after the lime and magnesia have been precipitated, the Voigt method being used for this purpose.

Although this process does not belong to the most rapid of methods used in the quick determination of lime in cement and cement products, nevertheless it is highly recommended for the reason that it is also possible to determine simultaneously the loss on ignition and it is also possible to use the appearance of the ignited product in making a qualitative estimation of the character of the lime. In order to obtain results that are as accurate as possible, it is necessary to exercise care to drive out all of the carbon dioxide from the carbonate, and on the other hand it is also necessary to see that the temperature is not so high that it causes the combination of the lime with the silica. If this happens it is evident that too low a figure will be obtained for the silica present in the sample. Then again, when the time consumed in the separation of the filtrate from the measuring flasks needs be saved, it is advisable to work with smaller samples that is 0.2 to 0.5 gram, and then the filtrate from the insoluble oxides is used in its entirety. On the other hand when smaller samples are used, there is increased difficulty in obtaining a constant weight on ignition.

Then again it should be remembered that this process is applicable only to the analysis of limestones, dolomites and similar rocks in which the lime and magnesia can be converted into the form of free oxides by simple ignition. Slags, cements and principally those substances in which the lime is present in part in the form of silicates, in part in the hydrated form, or combined with sulphur as a sulphide, cannot be analyzed by this method.

The method which depends on the determination of the volume of gas released from the sample is a very rapid way of determining the proportion of lime, present as carbonate, in the sample, but any magnesium carbonate also present in the sample is found along with the carbon dioxide developed from the lime carbonate. There are various apparatus which are employed in carrying out this determination, but it is not necessary to use a special apparatus for this purpose for the apparatus used in the volumetric determination of carbon in iron can also be used in this analysis. The method is as follows.

A sample weighing 0.05 to 0.2 gram (according to its carbonate content) and 0.07 gram of alumi-

num filings are placed in a hundred cubic centimeter flask provided with a wide neck and closed with a two-hole stopper. A funnel is inserted through one of the holes in the stopper and the stem is made to reach right to the bottom of the flask. An outlet tube is inserted through the other hole and this is connected with the cooling coil of the carbon apparatus, the glass tube ending directly at the edge of the stopper. The funnel tube is provided with a stopcock and ten cubic centimeters of a 1:3 solution of hydrochloric acid is allowed to flow into the flask and then the stopcock is closed.

After several minutes action in the cold the contents of the flask are heated with a small flame until the soluble portion of the sample and all of the aluminum have gone into solution. The level in the measuring burette filled to the top with water is lowered. Boiled water is then allowed to flow into the flask through the funnel until the flask is entirely full and then by lowering the leveling bulb carbon dioxide-free air is sucked through in such an amount until the level has sunk almost to the zero point on the measuring scale. After the initial point is determined, then the volume of gas is conducted twice into a solution of potassium hydroxide and from the reduction in volume it is possible to calculate the carbon dioxide or carbonate content, taking into consideration the barometric reading, the temperature and the tension of water vapor. One cubic centimeter of carbon dioxide at 0 degrees C and 760 millimeters pressure in the dry state then corresponds to 0.0025198 gram of lime. The addition of aluminum is for the purpose of driving out the carbon dioxide from the flask due to the evolution of hydrogen by the action of the acid on this metal. Furthermore the quantity of aluminum added is calculated in such a manner that the quantity of hydrogen gas formed approximately fills out the wide space above the measuring scale. The weight of substances used in making the analysis must be such that not more than forty cubic centimeters of carbon dioxide gas are formed.

When the limestone also contains magnesium carbonate, then the carbon dioxide corresponding to this carbonate is determined along with that coming from the calcium carbonate and the lime content is found too high. When the lime content has been determined in accordance with any of the other methods that have been described in this article, then it is possible to obtain the percentage of magnesium or carbonate in the sample by using the total carbon dioxide figure as determined in this method. For example, if the percentage of lime from the carbon dioxide determination is placed equal to a, and the lime present in the sample determined by another method is designated as b, then the magnesia content of the sample is given by the following equation: $MgO = 0.7191\ (a—b)$ percent.

It is finally necessary to say a few words regarding the determination of the silica, alumina, and lime in the sample.

In the standard method of analysis the precipitation of the lime in analyzing limestones, cements, slags and clinkers is carried out after the removal of the silica, alumina, iron and manganese (TiO_2). The silica is rendered insoluble by evaporation to dryness with hydrochloric acid, and when very accurate determinations are carried out the evaporation of the filtrate to dryness is repeated.

The filtrate that is obtained after the silica has been filtered off is then analyzed for iron and alumina, the sesquioxides, and these are precipitated in the usual manner by the addition of bromine water with a slight excess of ammonia, the precipitation taking place while the solution is being boiled. The precipitation must be carried out twice in order to make sure that all the lime remains in the filtrate. This is an important condition and must always be fulfilled for if it is not, then a certain small amount of the lime salt will be held in suspension by the aluminum hydroxide precipitate or will be absorbed by it in the form of lime carbonate, for there is always a trace of carbon dioxide in the ammonia. It is only on the second precipitation that this lime is released from the aluminum hydroxide.

The total precipitation of iron, alumina, and manganese is permissible only when a slight amount of manganese is present. When larger amounts are present, there is danger that the lime will be partially precipitated with the oxides of manganese. In such cases it is best to use the acetate precipitation process, which consists in precipitating the sesquioxides along with manganese in a slightly acetic acid solution containing bromine water and sodium acetate. The hydrochloric acid solution from the silica determination is accordingly neutralized with alumina-free sodium hydroxide solution or sodium carbonate until the solution is just slightly acid and then after this solution has been brought up to volume of 400 cubic centimeters an excess of a few grams of sodium acetate is added along with bromine water and the entire mass is then boiled. (Hans Pinsl, Zement, 1927, pages 591 to 594).

Conversion of Slags Into Cement

Gypsum or other compounds containing sulphur are mixed with slag and heated so that the manganous oxide is partly or wholly converted into manganous sulphide. Limestone is then added if necessary in order to give the slag the required composition for use as cement. S. Michelson (British Patent 267, 539 and B. C. A.).

(*Continued from page 54*)

In the third case the speed of heating the gypsum was at the rate of twelve degrees Centigrade per minute. The gypsum curve begins to deviate from that of the check test (silical), while a level stretch appears very clearly defined at a temperature of 140 degrees C and another one at a temperature of 191 degrees C.

In the fourth experiment the speed of heating was at the rate of twenty five degrees Centigrade per minute. The heating curve of gypsum is in this case very markedly separated from that of the silica check. The level stretches have disappeared but the two stages of dehydration are revealed by

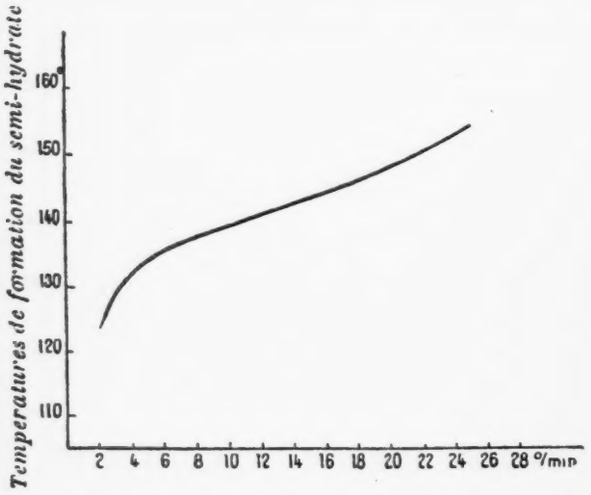


Fig. 3. Speed of Heating Plotted Against Temperature of Formation of the Semi-hydrate

two points inflection at 155 degrees C and at 192 degrees C.

It may be concluded from these experiments that the course of the dehydration of gypsum is a function of the speed of heating, which function is shown in diagrammatic form in figure 3.

Experiments have thus permitted the deduction of the conclusion that the temperature of the formation of the semihydrate increases as the speed of dehydration increases, but that the temperature of the formation of the anhydrite is not influenced by this factor from the practical standpoint, at any rate within the limitations of the speeds that have been studied. (Le Ciment, 1927, pages 201-2).

Estimation of Silica in Substances Containing Fluorine

A fluorine content up to 1% is without influence on the SiO_2 determination, and the usual procedure may be used. With higher fluorine content Berzelius' fusion method with $(NH_4)_2CO_3$ — ZnO precipitation gives exact results, if the filtrate and wash water is examined for SiO_2 content and evaporated and retreated if necessary. The acetic acid extraction method gives good and rapid results for the estimation of fluorspar. A. Stadeler (Stahl & Eisen, 1927, No. 16, p. 662-664).

Determination of Silica in Silicates By Means of the Ultra Filter

A superior method of determining silica which depends upon the use of the ultra filter (Figure IV) is described as follows: 1 gram of substance is mixed with 4-6 times its weight of sodium potassium carbonate and fused in the usual manner. The fused cake is removed quantitatively into a porcelain dish, and dissolved so far as possible in hot distilled water. It is then decomposed with a slight excess of hydrochloric acid. The liquid is evaporated until the silicic acid gel is formed, but not until the salts begin to crystallize. A mixture of alcohol and water is now added, the liquid stirred and heated and filtered on the "Cella-filter," washed

Figure IV

with water containing alcohol, the precipitate dried and weighed and then treated with HF if desired. H. Hardt (Zement, August 11, 1927, p. 678-682).

Alumina From Clay

Alumina is produced from clay by dissolving the clay in acid, separating the insoluble silicic acid from the solution, evaporating the solution and heating the salts thus obtained to decompose them into oxides and acids. The oxides are heated in a furnace with carbon until the mixture is decomposed into alumina and iron and an easily soluble metallic regulus is formed. Bauxite, leucite, phonolite and similar materials may be thus treated. With bauxite, however, dilute sulphuric acid is used to ensure a complete separation of the titanic acid. A. L. Mond (British Patent 272, 748).

NEW EFFICIENT SAND AND GRAVEL PLANT ENTERS FIELD IN MASSACHUSETTS

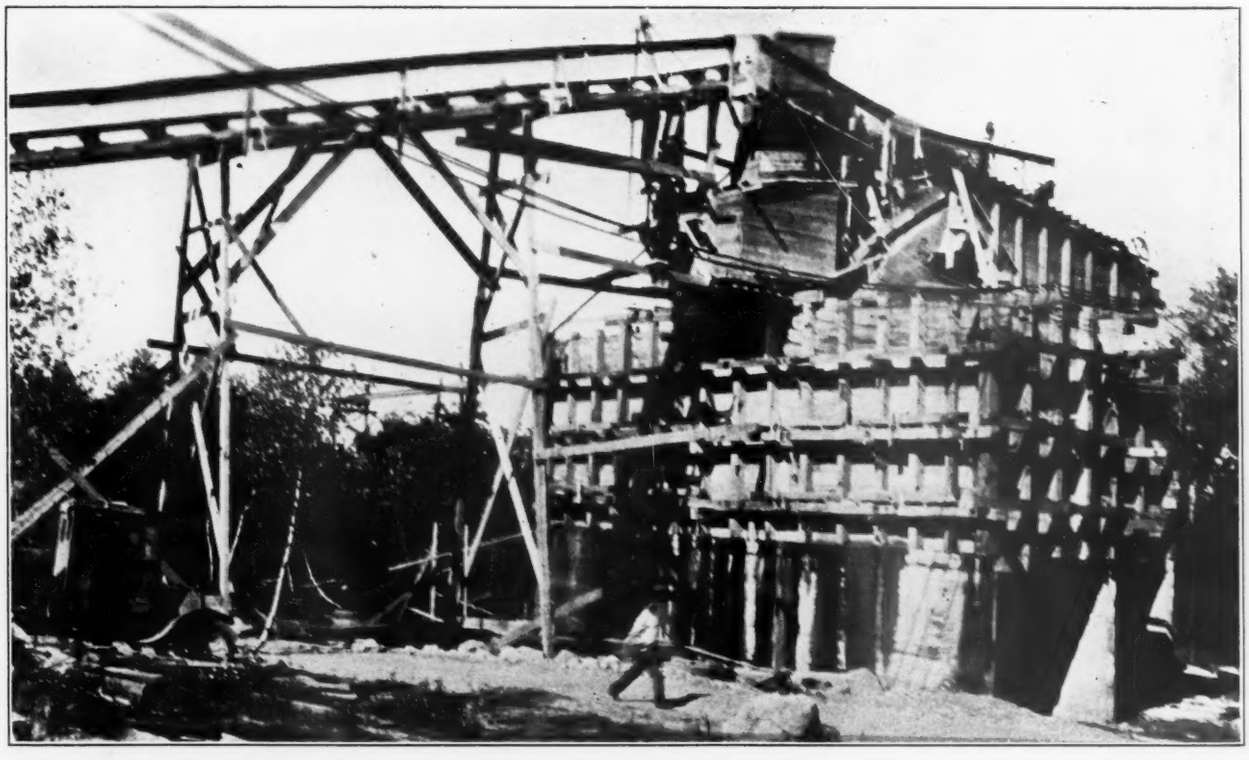
By George Rancom

D. S. SMITH, formerly manager and part owner in the Newton Sand and Gravel Company, has opened a new plant at Waltham, Massachusetts, which has been in operation since about July 1st. It has been designed for a production of 1000 tons per day with the present equipment and it has been laid out in such a manner that the production may be brought up to double that amount with the installation of a minimum amount of additional machinery. The plant was erected by the Good Roads Machinery Company and there are several features about it of decided interest.

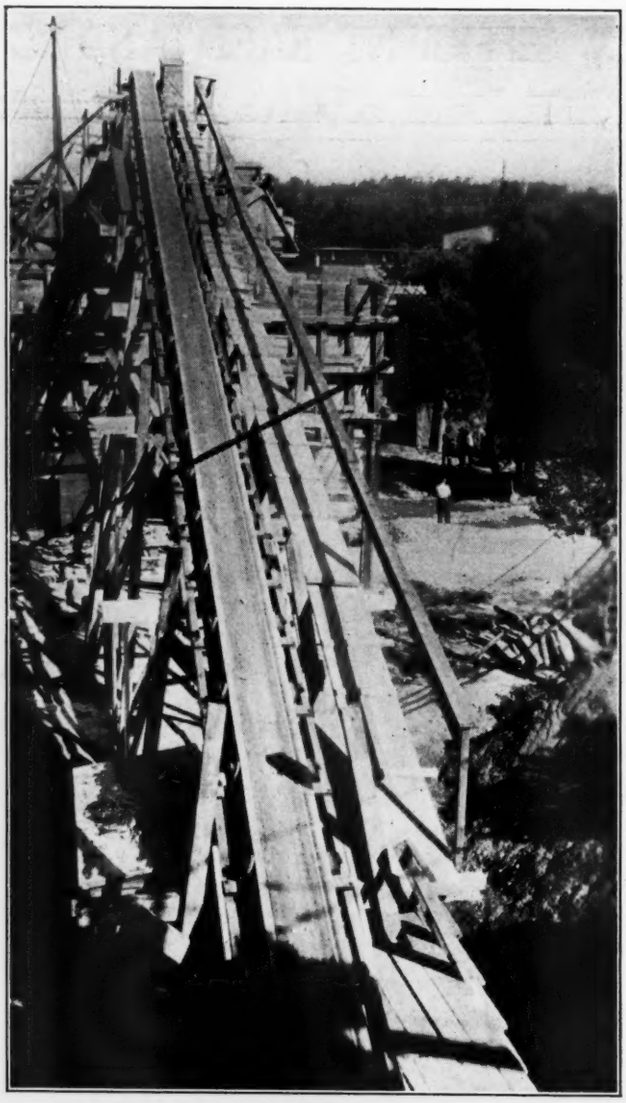
The bank is excavated by means of a Sauerman dragline scraper operated by means of a two speed Thomas hoist driven by a 90 h.p. Wagner induction motor. A square D safety disconnect switch forms part of the control equipment. This scraper pulls material into a grizzly with a hopper below and the latter discharges into a Good Roads cylindrical scalping screen. Here all sizes of 2 inch and larger are separated out as tailings and drop into a number 6 Champion jaw crusher. The troughs from the scalping screen and the stone from the crusher drop to a 24 inch belt conveyor consisting of Robin idlers and a Goodyear belt.

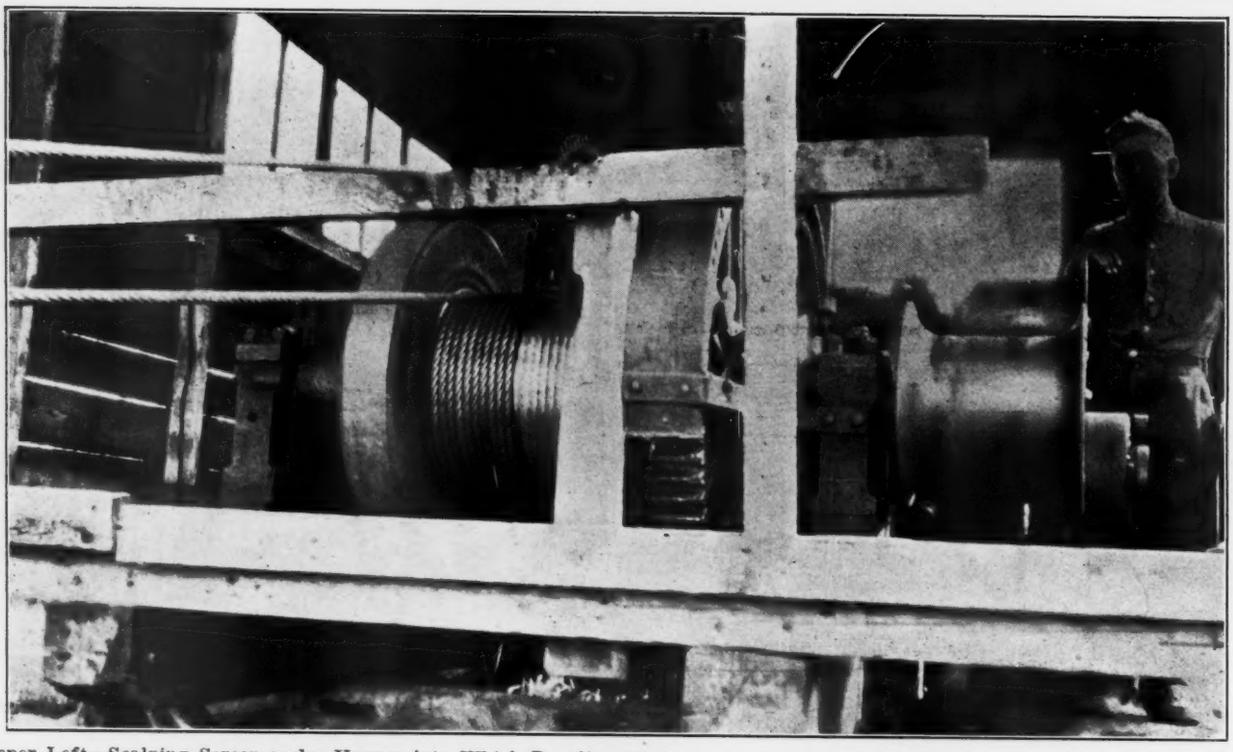
The conveyor carries the material to the sizing and washing equipment at the top of the plant. This consists of a three section Good Roads screen with jacket whereby two grades of sand and three sizes of gravel are secured. Two Good Roads sand wash boxes have been installed, one on each side of the screen, for washing the sand. The arrangement of bins is very practical. They are built of wood with concrete floors and foundations and there are four compartments for the storage of sand, two for each size. It has been found that when the freshly washed sand is allowed to remain in a bin for about two hours it becomes sufficiently dewatered to be in proper condition for delivery. Therefore the plant is so arranged that there is always approximately a bin full of sand of each size which may be drawn upon for customers while the other is being filled with wet sand from the wash boxes. Of course it is a simple matter to have movable chutes whereby the flow of wet sand may be directed into the proper bin.

It has been found that the demand for 2 inch gravel is as a rule very much below that of the other sizes. A small crusher, No. 1½ has therefore been installed into which the tailings, or 2 inch size, from the sizing screen may be directed, for reduction. This discharges into a separate bin.

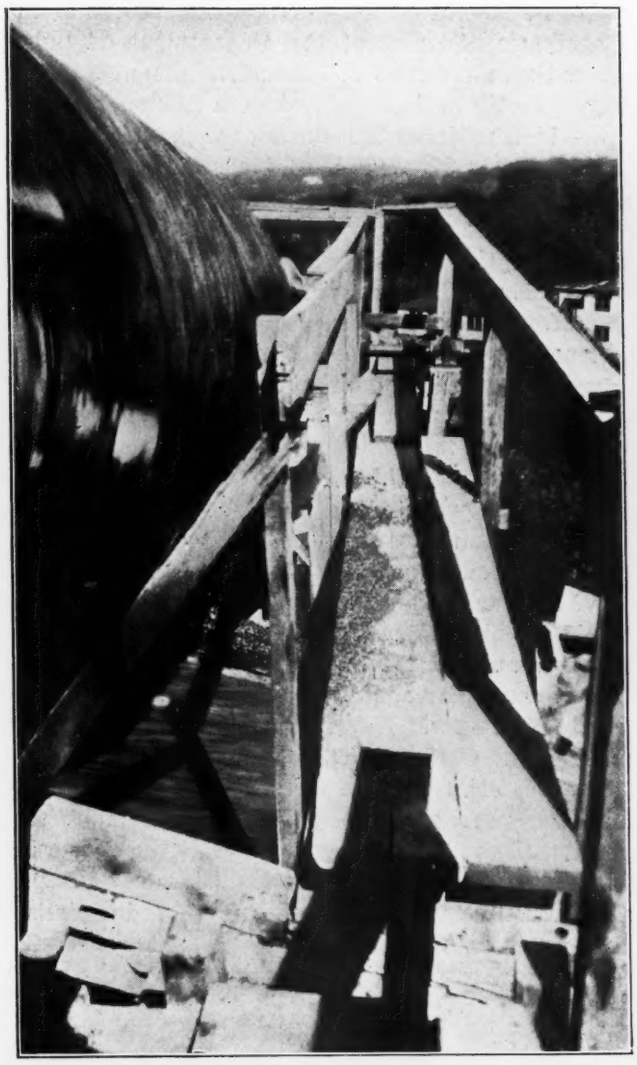


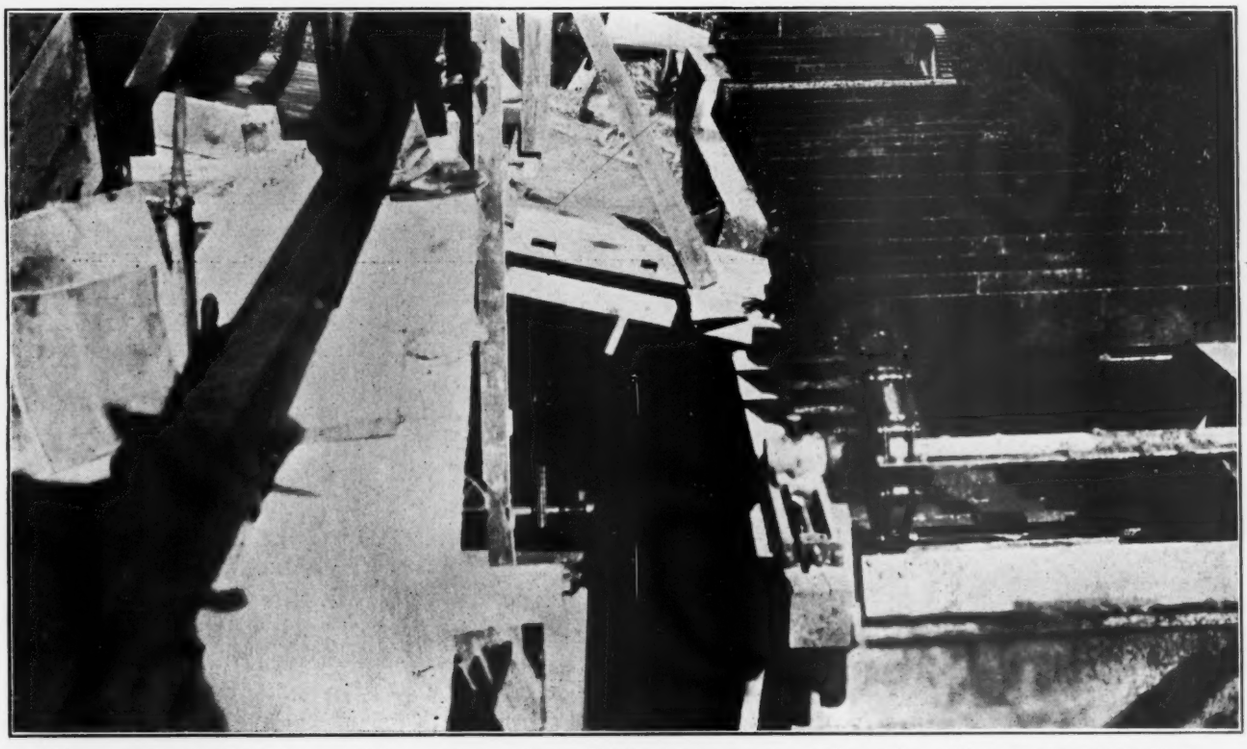
General View of Bins and Plant





Upper Left—Scalping Screen under Hopper into Which Dragline Discharges. Upper Right—Belt Conveyor from Scalping Screen to Sizing Screen and Wash Box Over Bins. Bottom—Hoisting Engine for Dragline.





Upper Left—Partial View of Sizing Screen. Upper Right—Drag Scraper in Operation. Bottom—The Wash Box.

Arrangement of Pulleys at Hopper End of Scraper

Water is supplied by two pumps, one of which is a Worthington.

The supply of water is obtained from natural swampy ponds adjacent to the plant, the overflow from the wash boxes being allowed to drain back. A very neat and substantial office building has also been constructed and provided with a Fairbanks scale. The Company owns only one Ford truck for use around the plant. Shipments are made in hired trucks or in trucks owned by the customers.

Measure the Profit in Conflict

One of the most encouraging business developments in recent years is the extent to which business men everywhere are grasping the great truth that strikes and lawsuits, like war, are unprofitable: that the Scriptural injunction to "Agree with your adversary quickly" while negotiation is still possible, is good business judgment. This work is proceeding on two lines, one dealing with disputes involving labor and the other with other kinds of business disputes, such as those involving contracts or deliveries.

In the field of labor mediation the records of the Conciliation Service of the Department of Labor show that more than 500 industrial disputes affecting, directly or indirectly, half a million workers, have been referred to it during the past 12 months. In more than 85 per cent of the cases handled, satisfactory settlements were obtained.

Strikes are so costly in lost wages, lost business and disruption of industrial organization, that even victory is usually barren of profit. It is gratifying, therefore, to note the spread of a spirit of reasonableness and cooperation. This is at least a partial answer to the criticism that material and industrial progress has far outstripped moral progress. Industrial conflicts seem to be growing more rare in this country and this constitutes an eloquent and practical answer to the preachers of "class consciousness and class struggle."

Arbitration of commercial disputes is newer. We have a Federal law under which the national Chamber of Commerce has adjudicated a number of disputes of an international or interstate character in which court procedure would have been difficult, costly, and slow. New York, Massachusetts, New Jersey, and Oregon have passed acts providing for voluntary arbitration of trade disputes through arbitrators provided by local Chambers of Commerce. Arbitration may be provided for in a clause inserted in each contract. Results are quicker and cheaper than recourse to court proceedings. Industrialists might well make use of these facilities where available or urge the passage of similar laws in the other states.

Lime

The reason why lime has not advanced with other building materials in coming within the range of scientific control is perhaps because of the difficulties of applying scientific tests and because lime is a product essentially for local consumption. According to a report on "Lime and Lime Mortars" issued by the Building Research Board (London) lime may be classified as (1) pure white or fat lime; (2) hydraulic lime with 20-30% clayey constituents and (3) a class intermediate between the two. According to the specifications, lime for use in mortar is not to be used if it contains more than 85% CaO except with additions such as burnt clay or crushed brick. For plastering it is stipulated that the lime must contain not less than 95% CaO and MgO. These specifications are "in fact counsels of perfection, and while probably leading to the production of better results in practice they must be adopted with great caution and with careful consideration of the existing conditions in the particular districts concerned." A "plasticimeter," an apparatus to make an accurate test of the plasticity of a lime for plastering is described. Editorial (Concrete & Const. Engineering, August 1927, p. 465-466).

WATCHING LITTLE PLANT DETAILS PAYS THIS CRUSHED STONE PLANT

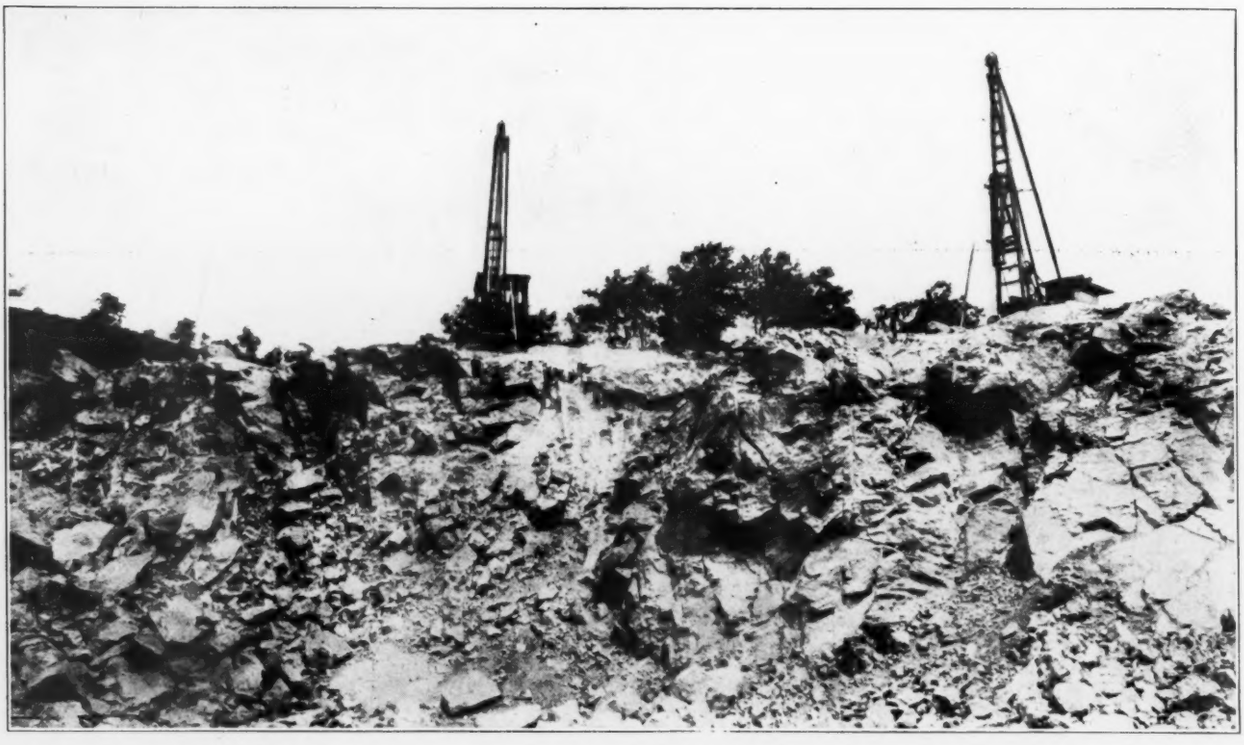
By F. A. Westbrook

THE General Crushed Stone Company has a large trap rock quarry at Winchester, Massachusetts, which is characterized by a marked neatness of upkeep and completeness of mechanical equipment. The quarry itself is in a side hill. The crescent shaped face is some 1800 feet long and varies in height from 85 to 165 feet. Drilling is done from the top by three electrical well drills, a Keystone drill, a Loomis Clipper drill and a Sanderson Cyclone drill. The holes are drilled to a depth of about 5 feet below the floor of the quarry, 20 feet back from the face and 12 feet apart. One or two of the illustrations show the mark of the bore holes in rather a remarkable manner and indicate very clearly how they deviate from the perpendicular due to changes in the inclination of the stratification. Sixty per cent Atlas gelatine dynamite is used for blasting. Secondary drilling, shown in one of the illustrations, is done by means of nine BCR-430 Ingersoll-Rand jackhammers with single edge cutting bits.

Partial View of Cone Crusher

Rock at the face is picked up by two Marion shovels, a Model 92 and a Model 76. The Model 92 is equipped with Marion caterpillars and a 3 yard Taylor-Wharton dipper while the Model 76 is equipped with Bucyrus caterpillars and a 3 yard dipper. Both dippers are provided with fronts and bottom doors of manganese steel. These shovels load the stone into Mack trucks. There are three of them making the trip between the shovels at the breast of the quarry and the primary crusher. On returning from the crusher the driver goes to whichever of the two shovels is either without a truck to load or has most nearly completed

Loading Trucks With Shovel at Breast of Quarry



Upper Left—Secondary Drilling. Upper Right and Bottom—Well Drills on Top of Quarry. Note Bore Holes.

loading one. By having three trucks and drivers properly acquainted with their work it is possible to keep both shovels busy practically continuously and the trucks as well. It appears to be a very practical and efficient working arrangement. Each truck carries 11 to 12 tons per trip and each makes about sixty trips per day, thus caring for a daily production of 2000 tons or somewhat better. The bodies were made by the Easton Car and Construction Company. In practice it has been found best to leave the tail boards down to facilitate dumping and to build up the head board somewhat higher so that the load may be piled up in front. It has been found by experience that these trucks are more satisfactory for the large production of this plant than dinky engines and dump cars on account of the short haul and level floor of the quarry.

The primary crusher is a 42 by 48 Traylor jaw. This discharges on a belt conveyor about 125 feet long equipped with a 36 inch Goodyear belt. Idlers for this conveyor are of Link Belt manufacture. At the end of the conveyor there is a bar grizzly. Pieces of stone which do not pass between the bars slip over into a number 8 Allis-Chalmers gyratory recrusher. Pieces which do pass between the bars of the grizzly drop into a Symons Cone crusher.

Stone from the number 8 Allis-Chalmers recrusher, as it is called here, and the Symons cone crusher is taken by an elevator with 30 inch buckets to the rotary scalping screen. The tailings from this are used for the large size of stone and the troughs go to a second revolving screen which has a jacket and gives several other sizes. These rotary screens are Allis-Chalmers equipment. There

Upper Right—Elevator from Bottom of Cone Crusher. Bottom —Dumping Truckload of Quarry Stone at Primary Crusher

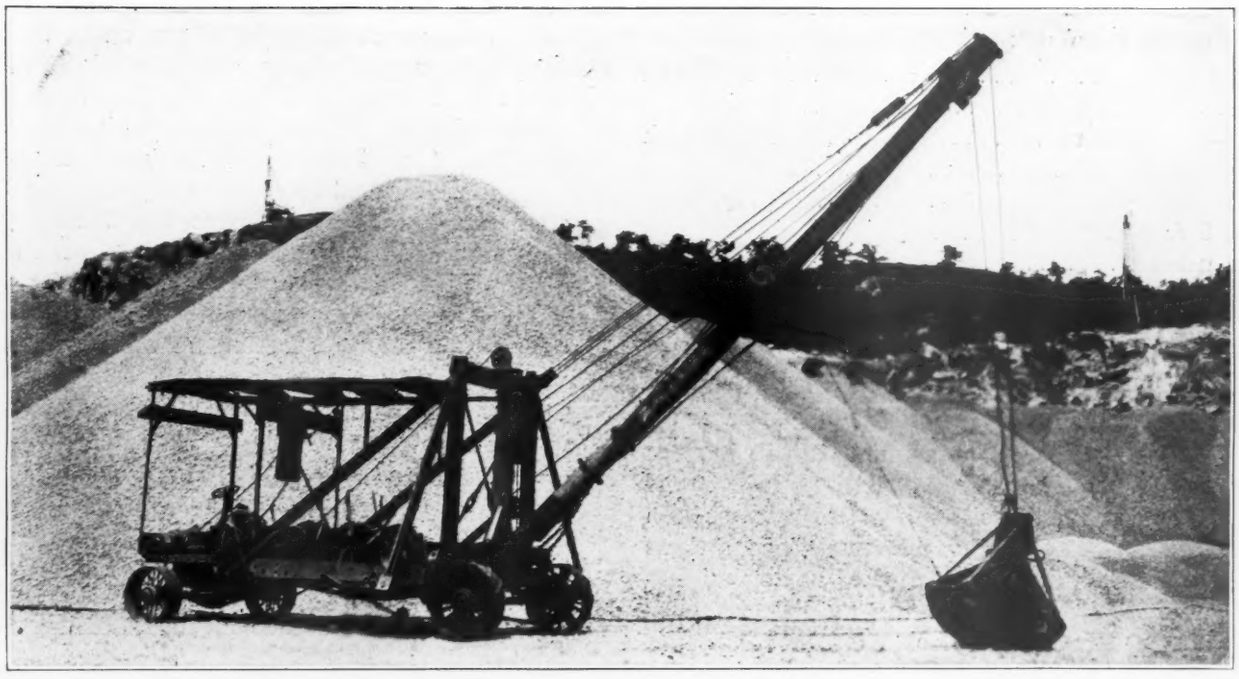
Shovel Working Stock Pile

is also a bank of four Hummer screens to rescreen the fine material. Each size is of course deposited in appropriate bins under which trucks and freight cars may be loaded. There is a siding from the Boston and Maine Railroad for freight car shipments.

Considerable amounts of material are stored from time to time in outside stock piles. A good sized space has been prepared for this purpose below the level of the floor of the quarry and adjacent to the railroad siding. Piles are made by dumping truckloads of stone off the quarry floor on to this prepared space, and as this pile grows the trucks of course back out over their tops. For loading trucks and cars at the stock piles there is a Thew Type O electrical shovel, which is also used for stripping. A Byers ¾ yard clamshell shovel and a Link-Belt loader are also employed in stock pile work.

A rather ingenious arrangement for economiz-

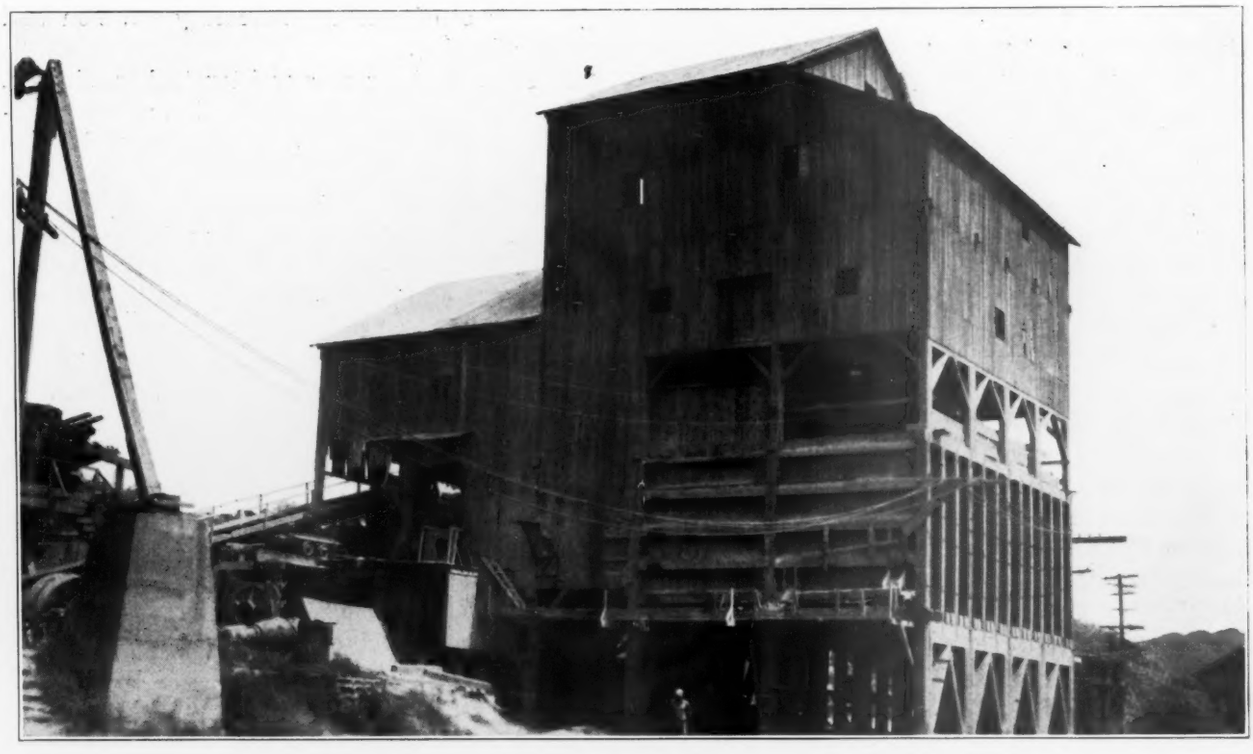
Conveyor from Primary Crusher



View of Stock Piles and Clamshell for Loading Trucks and Freight Cars

ing water has been worked out which is not usual to say the least. This consists of a tank on the floor of the quarry which is filled with circulating water from the air compressors and crushers. It is used for the steam shovels working at the breast of the quarry and for the well drills. A one ton Ford truck is used to carry coal to the shovels and water to the well drills as well as to run errands.

Air is supplied by two Imperial Type 10 Ingersoll Rand compressors having a capacity of 500 feet which are housed in a building by themselves. There is also a blacksmith and repair shop for emergency work and miscellaneous small repairs containing an Ingersoll Rand drill sharpener and various other tools. In addition there is another small house where there is a Gill bit sharpener for sharpening well drills. All machinery is electrically driven, mostly by Allis-Chalmers and General



Rock Bins. Primary Crusher at Left With Conveyor to Secondary Crusher

Electric motors. The sizes for the various machines are as follow:

Well drills	11 h.p. each
Thew electric shovel	20 h.p.
Air compressors	100 h.p. each
Jaw crusher	150 h.p.
Belt conveyor	15 h.p.
No. 8 Allis-Chalmers gyratory crusher	150 h.p.
Symons cone crusher	75 h.p.
No. 6 Allis-Chalmers gyratory crushers (no longer used)	40 h.p. each
Screens and elevator	150 h.p.
Hummer screens	belted motor-generator set

From the foregoing description it will be seen that the plant as a whole is strictly up-to-date and that many little, as well as big, things have been done to make its operation efficient. Among these is the well worth while practice of having all machinery continually oiled by an experienced oiler who does nothing else but look after the lubrication of the machines. Although not much has been said about it, it is evident that Mr. M. V. McKeon, the superintendent, is a strong believer in keeping his plant clean and neat and his machinery in first class condition.

Cutting Power Costs

Let a general manager inaugurate a campaign to save fuel and every eye will be turned on the power plant. Yet greater wastes of fuel occur in the transmission than in the generation of power; the one difficulty being that losses in expenditure are invariably multiple, small and invisible. Being invisible they are frequently overlooked. When recognized the smallness of the leak makes the loss seem inconsequential. But taken over the entire plant the many small leaks total an aggregate loss frequently in excess of any loss sustained in the ordinary boiler plant.

It is an unfortunate fact that in many plants the production department is at loggerheads with the engineering department, with the result that in the matter of making changes in equipment or methods to effect a series of small savings, there is a conspicuous lack of cooperation. Metering every department and charging each for the power used is perhaps the most effective way in obtaining the desired cooperation—of making the production department actually seek aid from the engineering department in power cost reduction.

One of the important places to look for power leaks is in transmission equipment. Belts, gears, speed reducers or silent chains will almost always give an efficiency of 98 per cent when first installed —but what will they give two years afterwards and what are they giving now? Actual tests of your present equipment will reveal a power loss of 15 per cent—from the same equipment that when installed gave an efficiency of 98 per cent. Such fluctuation more particularly applies to belt drives.

Obviously it would be impossible to catalog in this brief editorial all the ways in which power consumption (fuel bill) can be reduced. Power transmission was mentioned only as typical of the countless ways every management can employ. Just what needs to be done will largely depend on local conditions. In some cases it may be found that the expense of correction outweighs the value of the possible saving. Taking all the plants of this industry as a group, however, we believe it is possible to effect a 15 per cent cut in total power consumption through diligent and careful correction of minor leaks, outside the power plant.

Checking Tools In and Out

Any system that successfully checks tools in and out of the tool crib or stock room must accomplish four things, viz.:

a—Safeguard the tool loaner.

b—Safeguard the tool borrower.

c—Make possible efficient handling of tools.

d—Provide a record that will enable tracing and history of tool performance.

The usual single check system safeguards the loaner providing the system is honestly administered. Double check systems contribute to mistakes and costly losses due to their complication. What is needed by the average plant is a simple system that will work without provisos. Such a system has been devised by Gillett S. Schaller of the University of Washington, which we pass along to you for consideration, necessary revision and possible adoption.

"Insist at all times on a written tool requisition. Should the loaner be required to sign a tool requisition it is certain he will be very careful about his records, while the effect on the borrower's required signature to the same requisition is favorable since, because of it, he will be very certain about the kind and size of tools he asks for—which automatically eliminates discussion at the tool crib as the tools are checked out as compared with those returned. The loaner then has a receipt and the borrower feels himself doubly responsible for their safe and immediate return. It is sometimes well to have the borrower's time clock number affixed with his signature—a requirement which not only has a moral effect on the borrower, but enables rapid tracing of overdue tools."

This little system is simplicity itself, but in addition to that favorable feature it greatly aids the inventory of the tool crib, erases the buying of excess or needless tools, and either overstock or under supply. The running inventory which this little system provides also shows the condition of all tools at all times.

CRUSHERS AND THEIR COMPONENT PARTS

Wm. T. W. Miller

Part VI

PARTS one to five, inclusive, of this series of twelve articles have appeared in the past five numbers of Pit and Quarry. In them Mr. Miller described mechanisms applied to jaw crushers, jaws and check plates for rock crushers, toggles and toggle bearings, lubrication and the development of the gyratory crusher. In the sixth article, which begins below, Mr. Miller takes up the subject of crushing heads and concaves for gyratory breakers. The six future articles will appear in the ensuing six numbers of Pit and Quarry.

Mr. Miller, the author of this series, has had thirty years experience as a specialist in crushing machinery. For the last twenty-six years he has been employed by Hadfields, Ltd. of Sheffield, England. For the past eighteen years he has been in charge of their crushing machinery department. He has studied crushing problems in the United States, Canada, Brazil, Uruguay, Argentine, France, Spain and Portugal.—Editor.

THE gyratory crusher has proved its utility for many purposes and it must be admitted that, on the basis of power consumption and rate of output, it possesses advantages over the jaw crusher; but the latter has two points of superiority over its rival, that the wearing parts in contact with the stone are more easily renewed and that it is possible to regulate the size of the finished product with greater freedom.

It is therefore of special interest to users of gyratory breakers to see that the wearing parts are made of the most durable material and are so designed and fitted that they can be renewed with as little delay as possible.

The purpose of the following assemblage of facts and figures is to illustrate some of the various designs of cones and concaves and to explain how full advantage may be obtained from the latest developments in this direction.

In the first place, it should be clearly understood that the makers of gyratory crushers usually supply heads and concaves from standard patterns and of such dimensions as will give the desired product with from ten to fifteen per cent of oversize, when the head is set at its lowest position and the concaves are unworn.

The upward adjustment of the head is used to compensate for wear on both cone and concaves and is rarely available to give any great variation in the size of the finished product. As a matter of fact, in many standard machines, the adjustment is entirely inadequate to allow for the concaves to be worn out while maintaining the original size of product. It is therefore clear that special means must be adopted to obtain the full life from the crushing faces.

The most important wearing part is the cone or head attached to the gyrating shaft. This head may have either a smooth or corrugated surface or the upper portion can be plain and the lower corrugated. The smooth head has a longer life than the corrugated, but the latter gives a more regular product and, owing to freer crushing, it reduces the power consumption slightly.

In the early machines these heads were made from chilled iron, of the shape shown in Fig 1, and of such dimensions that they could be fitted directly on the main shaft. These solid heads are still used in many instances where the material being crushed is not particularly hard or abrasive.

With the advent of manganese steel the peculiar quality of resistance to abrasion possessed by this wonderful alloy quickly led to its adoption as the most suitable material for the wearing surfaces of the cones, but, owing to the heating and quenching treatment necessary with this steel and to the great difficulty in machining the fitting surfaces, special arrangements had to be made to produce heads to take the place of the original chilled iron parts.

An early design for a crushing head in manganese steel is illustrated in Fig. 2. Internal liners of special mild steel were cast inside the cone, leaving the outer shell of a suitable thickness to obtain the best result from the quenching process. The carbon content in the liners was kept so low that they did not harden but remained in a machineable condition after treatment.

Composite heads are still being made on these lines with varying results, for small cones, where the contraction is not great. This design may be satisfactory but, owing to the nature of the alloy, its low conductivity and its excessive contraction in cooling, the attachment of the liners to the thin shell is apt to cause cooling strains which render the castings unreliable.

When using solid heads of any size, the amount of metal which can be worn away before the head has to be discarded is extremely small in proportion to the total weight, and, as the vital wear is concentrated in the lower part, attempts have been made to build the heads in two or three annular sections, as shown in Fig. 3, each section interlocking with the other and held on the shaft by lock-nuts above the uppermost ring.

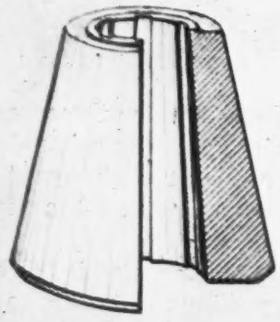


Fig. 1.

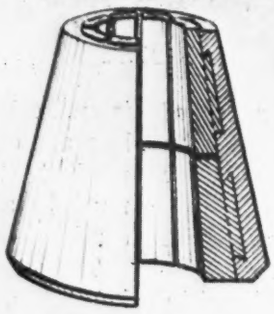


Fig. 2.

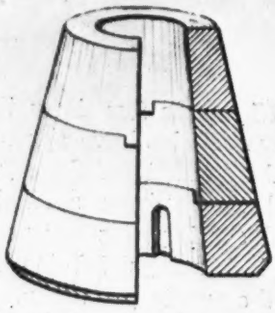


Fig. 3.

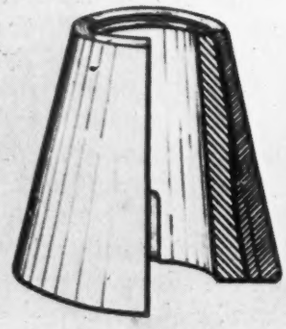


Fig. 4.

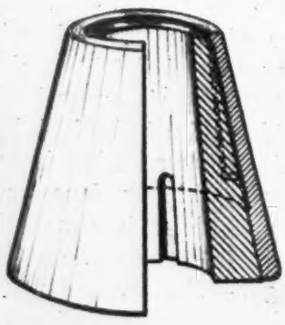


Fig. 5.

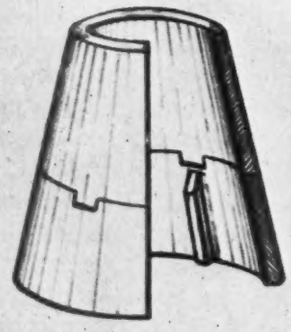


Fig. 6.

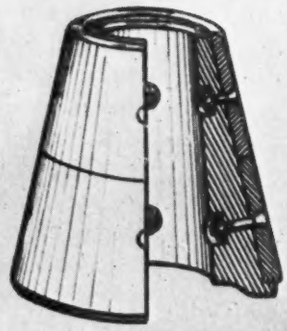


Fig. 7.

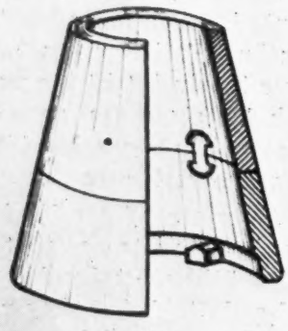


Fig. 8.

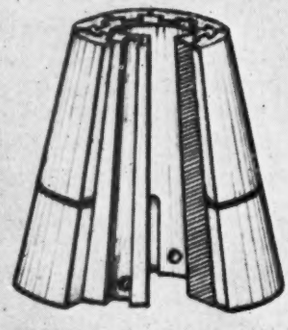


Fig. 9.

Fig. 10.

When two or three portions of a cone are made to fit on a common taper and each piece has to secure and tighten the part below, it is found extremely difficult in practice to renew one section and maintain accuracy of fit. The result is, that with a head made in two or three rings, it is rarely possible, after replacement, to tighten the sections equally.

To overcome this difficulty one European manufacturer secured the upper and lower heads on independent tapers, the upper portion being held down by lock nuts and the lower by hook bolts passing through slots in the enlarged center on the main shaft, as shown in Fig. 23.

This design has two defects, the first being that clearance must be left between the sections, otherwise there can be no guarantee that the upper ring is tight on its seating, and secondly, the nuts on the hook bolts are inaccessible when the shaft is in the working position.

The next step in the evolution of the modern gyratory cone is shown in Fig. 4. This head is made in two parts, a center of cast iron or cast steel, bored to fit the shaft and turned outside to the required shape, and a thin outer shell, usually called the mantle, made of manganese steel.

This alloy is unmachineable except by grinding and to overcome irregularities on the inner surface of the mantle and ensure proper bedding on the center it is usual to coat the inside with a layer of spelter.

In some instances the spelter is run on to the center in the form of an external coating of semi-plastic material and the mantle makes its own bed on the relatively soft surface of the center. The mantle is usually made with internal projecting lugs fitting into recesses in the center to prevent rotation.

When crushing hard material the spelter lining proves a source of weakness. It frequently breaks away near the bottom of the cone where the crushing pressure is greatest and the displacement of the mantle causes the whole of the lining to become loose.

With improved facilities for machine-grinding the inside of the mantles, this design has been improved as shown in Fig. 5. A broad band of metal to metal contact is assured by grinding the lower part of the mantle to the bed directly on the center, leaving the upper portion to be lined with spelter as in the earlier design. In order to give a clear space for the grinding of the lower internal surface, the lugs for preventing the mantle from turning have been lifted higher up the cone and the recesses cut in the thinner part of the center, which is not quite so good as the arrangement in Fig. 4.

Some manufacturers of gyratory crushers now make a standard practice, so far as their smaller machines are concerned, of grinding the whole internal surface of the mantle to template to ensure perfect bedding on the center. Mantles finished in this manner cannot have internal ribs which would prevent circular grinding and they must therefore be secured by other means of which more will be said later.

Although the introduction of the renewable sleeve or mantle considerably reduces the amount of metal which has to be thrown away when the outer cone is worn out, there still remains a high proportion of scrap, and various suggestions have been put forward to minimize this waste.

Fig. 6, illustrates a two-part mantle fitting on the center in a similar manner to that shown in Fig. 4. Both sections are lined with spelter, the lower having internal lugs to prevent turning while the upper has two projections engaging in slots in the upper edge of the bottom half, so that neither part can rotate on the center.

The design shown in Fig. 7. was used for some of the early Comet crushers in South Africa. The sections were bolted to the center and the bolts served the dual purpose of holding the mantles down and as checks against rotation.

This was a crude device, as the bolts could not be tightened without removing the center from the shaft, and the bolt heads, being of a softer material than the crushing surface, would wear away at a quicker rate, forming objectionable depressions in the exterior of the cone.

The two-part mantle, shown in Fig. 8, also emanates from South Africa, but, in this case the sections are machine-ground inside, being joined together by internal double-headed keys shrunk into suitable recesses in the castings. In effect this is a one-piece mantle when it is put to work and the keys have to be cut out before the parts can be separated and a new lower section fitted.

It is difficult to ensure such accuracy of finish inside that a replace part for the lower portion will match the upper section exactly. If the keys are fitted and the upper and lower parts ground as one, it may be possible to guarantee the correct taper, but the grinding of manganese steel is not quite so simple a matter as ordinary machining.

The mantle sections so far considered have all taken the form of separate rings, but Fig. 9, illustrates a design in which the wearing surface of the cone is divided into a number of longitudinal segments of manganese steel, each having dovetail projections engaging taper slots in the center and secured from vertical movement by a peg passing through from the bore into the lower portion of the segment.

The only advantage which can be claimed for this construction is that the segments are reduced in size and are therefore less liable to casting de-

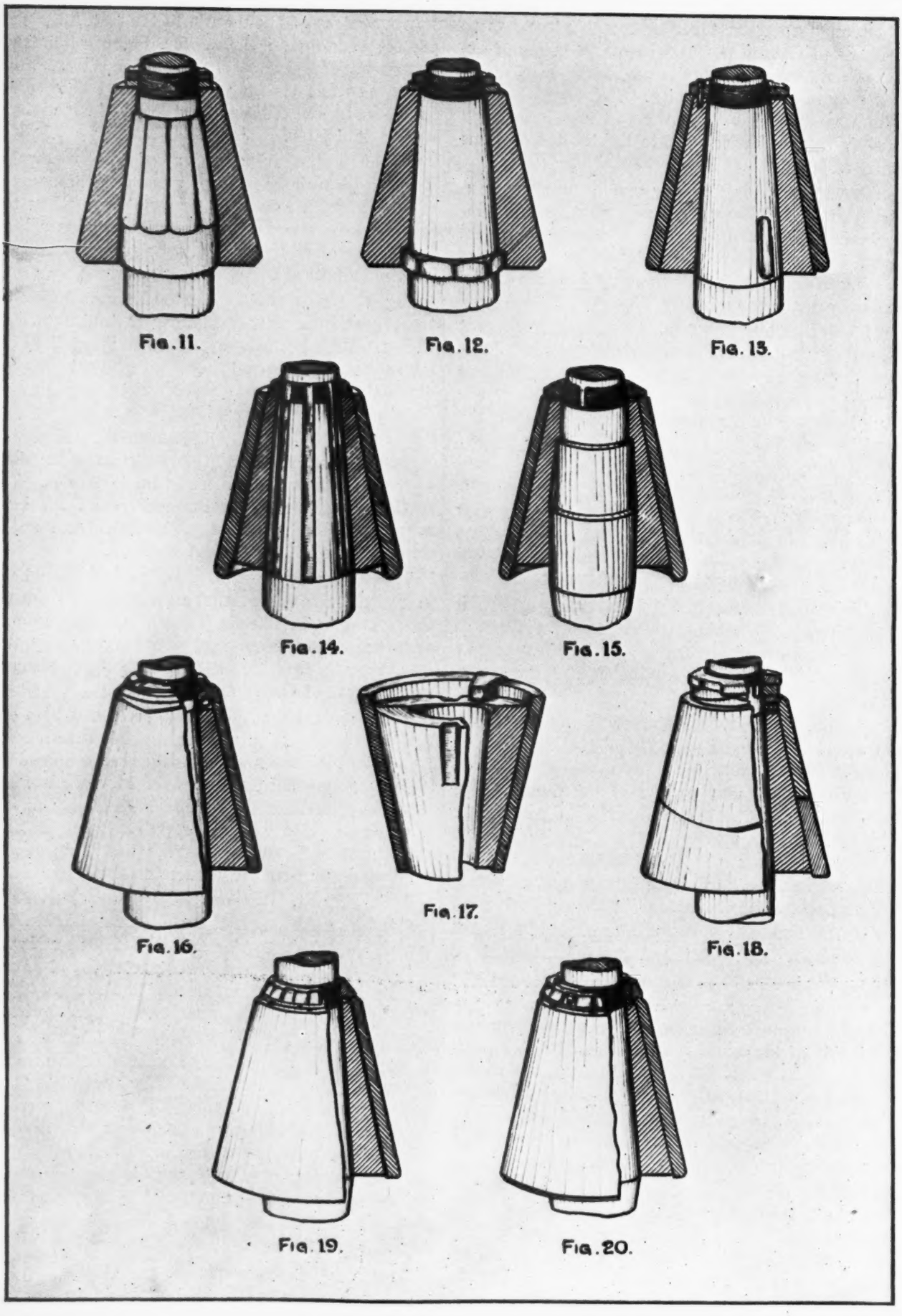


Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.

Fig. 18.

Fig. 19.

Fig. 20.

fects. The disadvantages are excessive first cost and great loss of time in renewing the wearing face.

Before proceeding further it would perhaps be well to refer to the various methods adopted for securing the mantle to the center and the head or center to the shaft. It is customary to fasten the cones to the spindles by means of single or double nuts screwed on the shaft and pressing down on the upper end of the head or center. This system applies to the designs shown in Fig. 1, 2, 3, 7 and 9, but in the composite heads, Figs. 4, 5 and 6, the nut is usually extended to cover the upper edge of the mantle which in turn forces the center down the taper body of the shaft.

It is quite evident that screw-pressure alone is not sufficiently positive to prevent rotation on the shaft and in the earlier machines various means were adopted to make a firm connection. Figs. 11 and 12, indicate two of the original methods used for fastening the head to the shaft in the Gates breakers. In the former the upper portion of the shaft immediately below the nuts was turned to a slight taper. This was followed by a length of octagonal cross-section, and below that the shaft was finished with a taper about one in forty.

This construction was simplified later, as shown in Fig. 12. The head was bored to a continuous taper and the octagonal collar forged on the shaft fitted into a shallow recess in the bottom end of the cone.

Fig. 13, illustrates a common system for securing the cone to the spindle. The head is locked against rotation by a feather key sunk into the shaft and recessed in the thicker part of the center, and is held against vertical movement by the pressure of the nuts on the wedging taper of the shaft.

In the design shown in Fig. 14 the center is held against independent revolution by means of spelter keys. The keyways are cast in the center and machined in the shaft and the head is driven on the taper with the keyways in register, after which molten spelter is run in to fill the cavities.

The most certain method of securing the center to the shaft is that shown in Fig. 15, in which the cone is made of cast steel and is heated and shrunk on parallel fitting bands on the shaft. When the work is properly carried out there is only one way to remove the center and that is to split it by machining.

Before leaving the subject of securing the head to the shaft it would be interesting to refer to the method illustrated in Fig. 25, which is taken from a pamphlet issued by a French manufacturer of gyratory crushers. The head is divided in a vertical plane and the halves are joined by bolts top and bottom. It is then bored as a complete cone, separated, and clamped on the shaft, fitting on parallel bands similar to these shown in Fig. 15. Vertical displacement is prevented by the solid collar in the center of the upper bedding ring which fits into a circular recess in the head.

Presumably the head is split along the bottom of two diametrically opposite corrugations and the bolts will require to be strong enough to resist the bursting action due to crushing stone between the walls of the corrugations.

When a composite head is used it is necessary to provide means for holding the mantle to the center, since it may tend to rotate independently on its support or move upwards with the changing thrust from stone nipped in the crushing basin.

As previously mentioned, the spelter lined mantles, shown in Figs. 4, 5, and 6 are often locked by internal keys or ribs and clamped down by nuts, and, as the mantles bed themselves under the crushing pressure, it is necessary to follow up with the lock nuts to keep them tight.

When the mantles are machine-ground inside, the internal ribs have to be discarded and some other device must be incorporated to prevent rotation. Occasionally a series of spelter keys, similar to those indicated for securing the center to the shaft, are used for fastening the mantle to the center, as shown in Fig. 10.

The gunlock mantle, illustrated in Fig. 17, is used very extensively and possesses several advantages over the earlier designs for machine-ground mantles in manganese steel. The head center is made as a casting turned true to shape and has two opposite grooves cut in the lower surface. The base of the cone instead of being square with the center-line of the head is formed into four radial inclined planes the crests of the spirals meeting on a diameter line at an angle of ninety degrees to the center-line of the slots.

The mantle is ground inside to a true taper, except for a narrow circumferential strip at the lower end, in which are cast two internally projecting lugs with double inclines on their upper faces. By passing the lugs through the grooves the mantle is slipped over the center and turned slightly until the lugs engage with the wedge-shaped inclines which automatically draw the mantle hard down on the cone.

When the crusher is at work, the rotation of the eccentric and the churning action of the stone is sufficient to maintain the twist on the mantle and, the inclines being formed both right and left hand, the direction of drive is unimportant.

This type of mantle has given good results for a number of years and, if correctly proportioned and designed, it stands up to the work very well. There are cases, however, where it fails through breakage of the lugs for reasons which will be stated later and to overcome this trouble several alternative patterns for self-locking mantles have been designed.

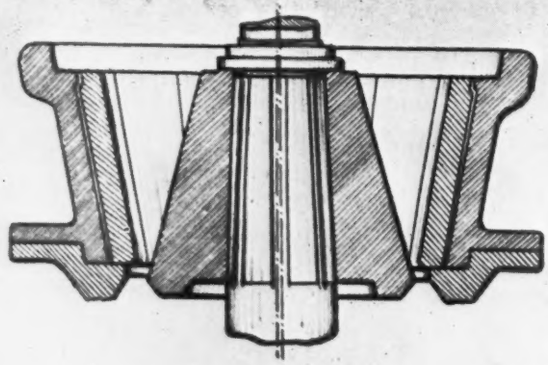


Fig. 21.

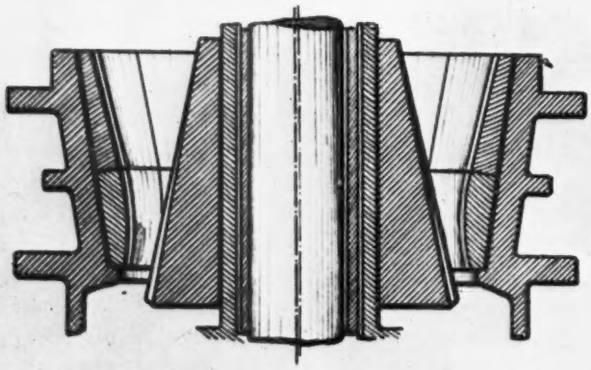


Fig. 22.

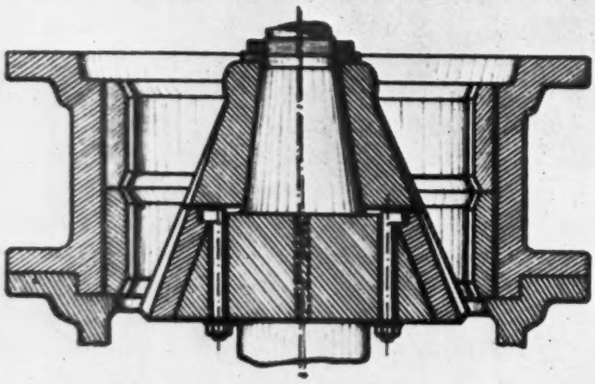


Fig. 23.

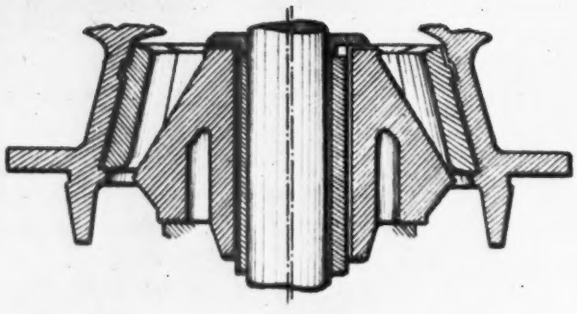


Fig. 24.

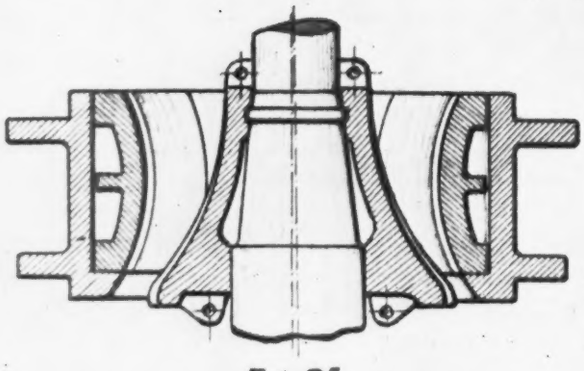


Fig. 25.

Fig. 16 shows a model patented in England in which the inclines are cast on the upper edge of the mantle and match reciprocal wedge-facings on a cast steel washer which has three depending lugs fitting into the top of the center to prevent rotation.

The upper face of the washer is cupped to register correctly with the spherical outer surface of the nut, which is locked on the shaft by a feather-key. The inclines on the mantle are six in number, three right hand and three left hand, and the spherical construction ensures that a positive three point contact is obtained in either direction without twisting or racking the nut.

Another design on similar lines, patented in the U. S. A., is given in Fig. 18, but in this case the washer is not self-righting and the component parts require to be accurately machined to ensure equal pressure on the inclines. In this instance the mantle is shown divided into upper and lower sections, the lower portion being locked to the upper by self-tightening inclines, resembling those at the top of the mantle.

It is obvious that any excessive displacement of the lower mantle will create a series of gaps or openings between the non-pressure edges and such cavities in a vital portion of the crushing surface might be expected to hold-up the stone.

It is possible to make the head self-tightening by utilizing the slight tendency which it has to turn on the shaft, making this act in conjunction with the holding-down nut, and a contrivance of this character is shown in Fig. 19. The thread on the shaft is cut either right or left-handed to correspond with the direction of travel of the head, the nut is screwed home and a locking-pin inserted between the nut and the mantle so that any rotary movement of the head forces the nut down the thread and tightens the cone on the shaft.

Fig. 20 illustrates another combination of this nature which is arranged so that the shaft may be made to revolve in either direction without changing the hand of the screw thread. The nut consists of inner and outer rings, the inner bore being screwed either right or left hand while the mid-joint between the rings is threaded the opposite hand. The inner nut can be locked to the shaft by a key or the outer nut can be fastened to the inner by a circular pin through the joint so that it is possible to choose which thread shall be made available for service.

The wear on the heads is usually concentrated in the lower third of the cone, particularly when the machine is set to give a relatively fine product. Many crusher mechanics fail to use the vertical adjustment of the head intelligently and allow the cone to remain for too great a length of time in one position, causing a circular ledge to form in line with the lower edges of the concaves, which impedes the free discharge of the crushed material and considerably restricts the output.

Sometimes this defect is not entirely due to faulty adjustment but may be caused by the head being placed too low on the shaft or being made too long so that the range of adjustment is inadequate to raise the cone sufficiently to wear the extreme lower edge.

With composite heads in which the mantles are made as thin castings of manganese steel this concentration of the wear frequently causes trouble in other ways. Manganese steel is essentially a ductile material in which the hard surface is artificially produced by the crushing action. This hard surface is of no great depth and the major portion of the thickness retains the property of ductility. Innumerable crushing blows on a material of this character are equivalent to cold-hammering a plastic body with the result that the mantle stretches under work.

If the crushing pressure was evenly distributed so that the stretch was equal from top to bottom the mantle would merely settle a little lower down the center and, with the aid of the self-locking devices, would automatically keep tight. Unfortunately, excessive wear near the bottom of the mantle causes greater stretch in this locality with the result that the mantle may be tight at the top and loose at the bottom. Any slackness of fit creates a destructive rolling motion which not only destroys the bedding faces of the center and mantle but also strips the threads in the lock-nuts.

There can be little doubt that the occasional breakage of lugs on the gunlock mantles and the peculiar chiseling effect which is sometimes noticeable between the lugs and the locking inclines are also very largely due to this irregular stretch under the crushing action, with the consequent disturbance of the contact faces. This trouble can be minimized by increasing the thickness of the mantle.

As stated in the introductory remarks, it rarely happens that the vertical adjustment for the head is sufficient to allow of the concaves being worn out and, in a great many plants, larger diameter heads are used to maintain the size of the product. In South Africa many of the mines are using three different sizes of mantles on the same centers and they have found this plan more satisfactory than resetting the concaves with narrower keys, when the limit of adjustment of the head has been passed.

The permissible variation in diameter of the mantles is governed by manufacturing limitations in the case of manganese steel and an alteration of two inches in thickness or four inches in diameter should cover the greatest working range between minimum and maximum on the same center.

The foregoing remarks have been confined to the heads but the concaves or liners for the crushing

basin are of equal importance. In the great majority of cases the concave-rings are divided into twelve or thirteen segments but in one or two instances the rings are solid.

The crushing surface of the concaves, as in the case of the heads, may be either plain or corrugated, or the upper portion may be plain and the lower corrugated. When they are made in sections the standard concaves have radial sides but one liner in each ring is made with parallel sides so that it can be driven inwards towards the center when it is necessary to remove the segments.

The concave liners usually rest on a ledge formed in the casing or body and are prevented from upward movement by lugs on the back which fit into a circular groove or under a projecting ledge near the upper edge of the basin. They are generally placed loosely in position, with small wooden packings between, to give the correct spacing and, after claying up the faces of the joints, they are run in with spelter. It is advisable, when the concaves are made of manganese steel, to have a clearance of at least three-sixteenths to one-quarter of an inch between the liners otherwise they may burr over until they form a solid ring and, in extreme cases, the force of the expansion may be so great as to rupture the outer shell or casing.

In standard crushers it has been the custom to design the concaves of a suitable thickness for satisfactory manufacture in chilled iron. When made in manganese steel these liners are hollowed out from the back and the cavities filled in with fine concrete or spelter. In the larger machines cast iron filler-pieces are sometimes used to reduce the amount of spelter.

The wear is greatest at the lower edge of the ring of concaves and it is therefore usual, in crushers of any size, to divide the liners horizontally, the upper series being of greater length than the lower. In most cases the concaves are arranged with tapering faces forming part of an inverted cone, the included angle between the head and the liners being divided equally between the two crushing surfaces. Such a combination as that shown in Fig. 21 will probably cover ninety per cent of the crushers in service.

In some instances the crushing face of the concaves is made with a curved profile as indicated in Fig. 22, where cambered liners are shown in opposition to a straight-coned head. Where it can be adopted without unduly increasing the angle between the cone and the upper part of the concaves (which is limited by the angle of nip) this curved shape has several advantages.

Correctly designed, with the curvature confined to the lower concaves, this combination has the effect of spreading the final crushing operations over a greater area, ensuring a more regular finished product and longer life for the lower concaves, as there is a band of some width which is practically parallel with the head. It should also be explained that it slightly restricts the output.

To be theoretically correct the superficial area of the outlet opening should be nearly equal to that at the inlet end, if the stone is to have ample room to spread sideways as it is crushed, which really means that the diameter of the annular outlet space should be as large as possible.

Some of the European makers and most of the manufacturers of fine-reduction gyratories have adopted a construction on the lines shown in Fig. 23, in which the whole of the angle is incorporated in the taper of the head and the concaves are essentially vertical. In the illustration, which is taken from a German design the concaves are made in the form of complete rings with internal corrugations and bevelled edges, so that by turning each ring over it is possible to bring four distinct crushing surfaces in line with the lower edge of the head.

Two of the leading builders of gyratories for secondary crushing adhere to the system of vertical concaves in the form of separate liners. In one case the segments are speltered inside the casing, which is so designed that it can be inverted to reverse the concaves; in the other the liners are fitted loosely into the container, with thin wooden strips between adjacent sections to allow for expansion, and with a wedge-piece or making-up section pulled into place by a single bolt. With this latter method the concaves are dismantled and reversed when the lower edge has become badly worn.

In a few instances the tapering sectional concaves of the standard type, shown in Fig. 21 have been modified to make them reversible, end for end. To effect this change the liners have been made of a double-wedge shape, the crushing face being curved to a uniform radius corresponding with the mean diameter of the concave crushing surface. Instead of following a uniform taper the sides of the liners narrow equally from the center of the length and, when the castings are laid in position in the casing, the joint faces agree below the middle line but leave a wedge-shaped opening above the center, which is filled by independent liners between each pair of concaves.

Strictly speaking, such concaves cannot be curved correctly on either their front or back faces to correspond with the varying diameters of the casing. In practice this departure from the true theoretical line is not of great moment.

The Telsmith reduction crusher may be quoted as an instance where an attempt has been made to bring the superficial area of the inlet and outlet openings into closer agreement. On examining Fig. 24, it will be noticed that the sectional view indicates the crushing face of the concaves overhanging the head so that the mean diameter of the

outlet opening is considerably greater than that at the inlet end.

Concaves arranged in this fashion are usually laid in position and backed with spelter with the casing turned over to bring the bell-mouth uppermost.

Fig. 25 shows a series of reversible concaves, with a very decided convex section, working in combination with a dished or bell-shaped head. The advantages to be gained by this construction are not very evident. It might be claimed that the crushing faces are lengthened without increasing the height, or it may be that it is intended to break the long flakey pieces, but the concaves are cumbersome and unwieldy and it is doubtful if the design possesses sufficient merit to outweigh the disadvantages.

The development of any machine from the original crude idea to the finished product is usually the result of years of adaptation to service conditions. The radical changes in design are few but the minor alterations are frequent and, in the end, are often more vital to the economic working than those which appear so spectacular. The gyratory crusher is established as a sound and reliable machine and improvements in the details will still further add to its laurels.

Comments

Among the letters commenting upon this series of articles on crushers that have been received by the editor is one from William R. Young of Earle C. Bacon, Inc. which contains information of practical value. Because this letter offers data contradicting some of Mr. Miller's statements we publish it here.

"We have read with interest Mr. Wm. T. W. Miller's article on crushers and their component parts, and must take exception to his statements on Blake type crushers as stated on page 97, your issue of August 17th. The article refers to Blake type, etc., stating that the trouble increases with the size of machine, making it advisable when the feed opening exceeds 36 by 24 inches, to water cool the upper pitman and the lower frame bearings.

"We have found that this is not the case, and that any amount of water cooling surface on top of pitman was insufficient to take care of any sudden rise in temperature, due to grit or foreign matter working into bearings, and it is impossible with class of help in crushing plants to prevent this when grease is used, with the result that the top of pitman, being cool from water jacket, gives a false sense of security and bearing is burned out before it can be taken care of. We have water in grease boxes in pitman and main bearings, and babbitt cannot run as long as water is in boxes, as the temperature cannot rise about 212 and bearing can be looked after before babbitt is changed. We run our crushers up to 36 by 24 inch size, 300 rpm., 60 by 42 inches and 60 by 48 inch size, 200 to 225 rpm, and do not have any trouble with heating.

"Referring to removable bearings, we have tried them out and found same expensive and inefficient, as we have found it impossible to keep a half bearing from buckling on shaft, when crushing very hard rock, even with very large ribs or flanges of bearing heated, and our "Farrel" crushers, running as they do, from one to several seasons without rebabbitting, it is not necessary to have these half bearings and the additional cost of same.

"Referring to page 18, regarding the design of the bearings, it may be said, that except in very small machines, the practice of running babbitt metal into cavities in the side frames to form the bearings has been practically discarded and removable half castings are now fitted in almost every instance. When bearings are babbitted, the babbitt is held rigidly by grooves in casting and cannot crawl or bind on shaft, as in the case of loose bearings, and can be rebabbitted in a few hours.

The chief engineer of a very large mining and smelting company informs us that he can rebabbitt any of his three 42 by 30 inch machines (which are down in shaft) in about three hours, and claims he uses grease in combination with water, and only used about 30 lbs. of grease per month on each of his 42 by 30 inch crushers, and crushing very hard nickle ore. We know of cases where our machines run for several years without rebabbitting. One 42 by 36 inch crushing hard dolomite, ran 11 years without rebabbitting. A 36 by 24 inch has run 18 years on very hard trap rock and only rebabbitted three times.

"On page 102 the author states "Cast iron should never be used for the bushes (swing jaw" as it tends to crumble under the ridging action, etc., but cast steel or phosphor bronze will be satisfactory." This is another statement which is not true, as we use soft grey iron exclusively for bushings, and have never known one to crumble until worn through and not even then. Soft grey iron will wear shaft less than bronze or steel and last longer. One of our customers has three 60 by 42 inch crushers crushing hard trap rock down to 4 inches, and the men in charge state they run as "cold as ice" lubricated with grease and water."

Limestone Calcined in Vertical Kilns Fired by Gas

The gas is burned under pressure in mixing burners with sufficient air for complete combustion, the products of combustion being injected into the kiln through nozzels which maintain a temperature zone of at least 900 degrees C. E. Lavandier, etc. (British Patent 246, 485 and B. C. A.).

CONTRIBUTIONS OF ANALYTICAL CHEMISTRY TO PRODUCTION, RESEARCH AND USE OF PORTLAND CEMENT

By V. Rodt, Berlin-Lichterfelde*

Part I

WHILE branches of scientific research other than analytical chemistry rank in the foreground at present in the domain of the study of the constitution of clinker and the hardening processes, analytical chemistry in the past half century, however, has successfully contributed to all the branches of knowledge concerning Portland cement and has opened new channels of research which have led to later discoveries of consequence. The work of German research workers, many of whom are connected with the German Portland Cement Manufacturers will be dealt with here.

Production

At the time of the formation of the Society of German Portland Cement Manufacturers the old empirical rule of thumb methods in the production of Portland cement had given way to the observation of the hydraulic modulus propounded by Michaelis placing a rational production of raw slip on a firm basis. Although the Society at that time, not long after its foundation, had its hands full with techincal problems, the necessity for lines of demarcation between the new product and inferior materials became imminent. Accordingly, intensive research was devoted to the discovery of methods of testing for the characteristics of its quality and the absence of adulterations. This work led to the establishment of standard specifications.

At the instigation of the Society, R. and Th. Fresenius developed the first analytical methods for the detection of subsequent additions to cement, especially additions of slag. These methods were founded upon estimation of the alkalinity on the treatment with water, the consumption of permanganate on acid treatment under closely prescribed conditions, the amount of carbon dioxide taken up, the ignition loss in stored and incinerated samples of the cement and the specific gravity.

There prevailed for a long time a difference in opinion in regard to the reliability of these methods and after the introduction of rotary furnaces the permanganate method for the detection of slag showed itself unreliable to such an extent that it was replaced by Fresenius by a method based upon the consumption of arsenious acid upon the treatment of the cement with solutions of this acid. Upon the incentive of Schott, Dyckerhoff, Goslich and Meyer, the detection of slag was later carried out by a separation into lighter and heavier constituents by sedimentation or by sifting with subsequent chemical examination of the separated components. This method was further perfected by v. Wrochem in the Royal Institution for Testing Materials by the introduction of sedimentation in methylene diiodide and sulphur determination in the separated lighter and heavier components.

The chemical basis already mentioned for the production of cement based upon the observation of the hydraulic modulus was further developed by Kühl, the genial successor of Michaelis. Kühl found that with reference to the property of combining with lime, three molecules of silicic acid are equivalent to four molecules of alumina, and that the cements with a ratio of silicic acid to the sum of alumina and oxide of iron of 2.7, can bear the largest amount of lime and in this case also exhibit the greatest strength. He designated the ratio of silicic acid to the sum of alumina and oxide of iron SiO_2: (Al_2O_3 + Fe_2O_3) as the "silicate modulus." As furthermore, it was found that cements rich in alumina could be kept richer in lime than cements rich in iron with the same silicate modulus, the relation between alumina and oxide of iron, designated by Kühl as the "iron modulus," in similar fashion to the silicate modulus gained a special importance in the preparation of raw material for high grade cements.

The observations of Kühl were fully confirmed some years later by Schott who produced cements by the burning of a very great number of mixtures of penta calcium disilicate ($5CaO.2SiO_2$) and tri calcium aluminate ($3CaO.Al_2O_3$) as well as of penta calcium disilicate $5CaO.\ 2SiO_2$ and tri calcium ferrite ($3CaO.Fe_2O_3$) with continuously increasing amounts of lime; and studied the influence of the composition upon the tensile strength and crushing strength. At the same time, Schott made the observation that cements rich in iron require a higher burning temperature and set slower.

He showed, furthermore, that clinker with a high silica content (25 per cent) with a concurrent low lime content (50 per cent) shows the phenomenon of cracking. The cracking did not occur when this clinker was burnt again with an addition of lime, it having nothing to do with the particles of iron enclosed in the clinker nor with the carbon monoxide atmosphere in the fire space, but de-

*From Zement, July 21, 1927, p. 615-617.

pended upon the taking up of ash rich in silica by the clinker, and Schott attempted to explain it by the formation of calcium disilicate.

Defects in construction, due to the use of Portland cements rich in magnesia as later investigation showed, drew the attention of the Society even in its early days to the influence of the magnesia contained in cement. R. Dyckerhoff found that the collapse of cements with a high magnesia content, especially in the case of dead burned clinker, occurs in the case of rich mortar mixtures and contact with water and is especially serious as it does not occur until after a long time. At the result of extremely extensive experimental material used by Dyckerhoff and the Royal Institute for Testing Material, the permissible magnesia content limit in Portland cement, as the result of many years of consideration, was fixed first at three per cent, later at five per cent.

The publications of Candlot and of Michaelis on the dangerous influence of gypsum upon Portland cement as the result of the formation calcium aluminium sulphate which exerts a disruptive force upon the cement constituents have brought about an extensive research upon the nature and action of addition of gypsum to cement, undertaken more especially by Schott, Klinkenberg, Strebel and Framm.

Schott examined the action of large amounts of gypsum upon basic calcium silicates prepared especially for this purpose, upon cement prepared from calcium carbonate and kaolin and upon iron cement (ore cement). It was found that gypsum had no disruptive action upon di calcium silicate. The rapidly setting di calcium aluminate became remarkably slow setting, showed great expansion and broke up in water into compact pieces, while the cement containing alumina gradually fell into a paste. The iron cement showed an expansion but did not break up, the surface, however, foliated upon longer contact with water with separation of calcium hydroxide crystals.

As a result of the study of the water of hydration content of dicalcium silicate alone and of its mixtures with from 1 to 3 molecules of gypsum, Schott and Klinkenberg gave to the calcium eluminium sulphate, the cause of the disintegration, the formulae $2CaO.Al_2O_3.2CaSO_4 2aq + 18H_2O$. Di calcium silicate, on the other hand, in a mixture with gypsum did not give any water of hydration compound, and showed itself here as well as in the above mentioned case to be wholly indifferent towards gypsum.

Strebel has studied the action of gypsum upon cement mortar in the proportions of from 1:2 to 1:10, subjecting Portland cement rich in lime, Portland cement poor in lime, iron Portland cement and ore cement, exposing them to the action of gypsum solution, sometimes for as long a period of time as five years, the results being the following: Mortar bodies from ore cement remained sound, although the analyses in the case of the mixtures 1:5 and 1:6 showed a large increase of sulphuric acid content in the cement. In the case of mortar bodies made with the other cements there was invariably the eminent fact that 1:5, 1:6 and 1:7 mixtures showed a very high increase in the sulphuric acid content of the cement and were distroyed, while 1:2, 1:8, 1:9 and 1:10 mixtures contained much less sulphuric acid in the cement and remained in a good state of preservation. A loss in lime of the cement in the various mixtures was also in keeping with this. Accordingly, very rich and very lean mixtures are not attacked while the others are destroyed. An explanation of this remarkable behaviour can only be sought in the different density and porosity of the mortar bodies.

Framm has examined a large number of Portland cements of the most varying composition with regard to the action of increasing additions of gypsum upon the special stability and has fixed permissible maximum content in the different cases. The most rapidly setting cements which had received the most careful preparation and the most extensive fine grinding stood the highest additions of gypsum, the intensity of the burning temperature not making for any increase in this respect, moderately burnt cements were even improved by an addition of gypsum. Upon hardening in the air there was hardly any disintegration to be noticed. On the basis of his observations, Framm declares himself an opponent of a classification of cements according to their sulphur content and to the fixing of a miximum for the sulphuric acid content, as the physical tests offer sufficient indications for the detection of disintegrating cements.

The influence of additions of fluorspar to the raw material for burning Portland cement was formerly looked upon with disfavor by Michaelis and Erdmenger in the case of cements poor in lime in their time (1882) on account of the discoloration of the resulting clinker and the deficient initial setting of the resulting cement. Inasmuch as conditions have changed through the production of cements rich in lime as well as the production of cement from blast furnace slags and lime in recent times, new investigations have been carried out, by Kühl in collaboration with Becker and Wehrmann with reference to the first problem, and with reference to the latter by Guttman and Biel which have led to the following results: An addition of from 3 to 5 per cent fluorspar lowers the sintering temperature considerably, in the case of raw material of clay and lime about 400 C. (725 F.), and in the case of blast furnace slag and lime, about 150 C. (302 F.). The lower amounts of fluorspar do not bring about any objectionable discoloration of the clinker, nor any disturbing cracking of the clinker through production of dilcalcium silicate which has a cracking effect, if the burning be carried out at the

proper temperature. The special stability is improved in cements of a low special stability, the initial hardening, on the other hand is decreased, but this loss in initial hardness is however, later, regained.

The quality of fluorspar added depends upon the lime content of the clinker, but should not exceed the above proportions in order to be non-injurious. The fluorine loss in the clinker is very small in additions up to 1,400 C. (2,552 F.), but strongly increases with large additions. As to whether the shortening of the setting time which is to be observed in the freshly made products will remain upon proper storage of the cement still remains to be seen.

In regard to the influence of the titanic acid contained in cements the work of Kühl and Omar has shown that the small amounts of titanic acid ordinarily occurring in Portland cement do not have any appreciable effect upon its properties, but that the replacement of silicic acid by titanic acid to a larger percentage has a very injurious effect on the quality of the cement.

Make Use of Uncle Sam

It is always well to remember that the United States Government is the largest single purchaser of supplies and materials in the country, and that these purchases cover a wide range of articles. They are based on definite specifications and sellers may obtain from the Superintendent of Documents at Washington, Publication No. 90 (15c), which gives a list of 207 commercial laboratories which are now prepared to test articles to ascertain whether they comply with government specifications.

The advantage of having your product tested and certified as meeting government standards is twofold: It not only prepares you to bid for government orders, but there is a good advertising value, and an excellent selling argument in being able to say, "Our product is tested and certified as meeting all United States Government standards." Another useful publication obtainable from the same source is a copy of the rules for simplified practices in 62 trades and industries (price 5 cents).

Some very thorough and complete surveys of the industries and markets of a number of the most important districts of the country are now being made by the Bureau of Foreign and Domestic Commerce. A report on the Philadelphia District came out about 18 months ago and can be obtained from the nearest office of the bureau, or from the Superintendent of Documents at a cost of 20 cents per copy.

A report on the New England District is nearly ready. Preliminary reports covering 113 industries will be ready for release early in August and may be obtained from the New England Council, Statler Building, Boston. Surveys of San Francisco and Atlanta Districts have been started. Manufacturers, with both local and national distribution would do well to have these reports on hand for guidance.

How About Apprenticeship

Restricted immigration has reduced the nation's manpower, is the statement made by a bulletin recently issued by the Chamber of Commerce of the United States. This, together with the tendency for boys to drift into clerical or office work regardless of opportunity for future advancement, has caused a serious shortage of trained workmen, which shortage it is felt will continue to increase as time advances. All of which clearly indicates the growing need for apprenticeship encouragement and training.

As in everything else since before the present decade, apprenticeship has changed to meet changing conditions and demands. Notwithstanding, indeed we might say because of, the great growth of labor saving and aiding machinery there is abundant room for brains and skill in industry. American business men, in what ever line, can do nothing more important, either to their own individual businesses or to the welfare of all industry, than the educating and training of young men whose apparent abilities and prospects for success lie along industrial lines.

Not only does apprentice training provide a valuable source of supply from which foremen may be drawn and executives developed, but it creates a supply of trained workmen who are at once dependable, efficient and capable. The trained workman is invariably more loyal to his employer than the untrained man. Apprentice training thereby reduces labor turnover.

Until comparatively recently it was considered that only the larger companies could profitably and successfully conduct apprentice training schools. This erroneous belief, is happily being overthrown by the number of actual working cases that definitely prove the contrary. Many small concerns are today conducting training schools with a marked degree of success. Further, within the past few years a number of associations have attacked the problem by establishing such schools for all young men inclined to take advantage of the training this afforded.

That immigration limitation is of great and far reaching benefit to the country few will deny. That it entails the obligation of more active interest and greater effort in the teaching and training of skilled and semi-skilled labor is also apparent. Every industrial executive should do everything in his power to further the work of apprenticeship training—work which will mean so much to the American industry of tomorrow.

ACTION OF ADDITIONS OF FLUORIDES TO GLASSES AND ENAMELS

By G. Agde and H. F. Krause*

Part I

IN INVESTIGATING the elastic properties of enamels which were made opaque with fluorides the authors repeatedly found divergencies which were far in excess of the errors of measurement inherent in the testing methods used. The methods of fiber tension and of bending of small rods were used. As the above mentioned deviations to a certain extent accompanied and corresponded to the roughening of the surface of the test pieces the latter were examined for the presence of devitrification phenomena. In this investigation it was found that the latter phenomenon was due to the formation and separation of very fine crystals and further experiments showed that the same crystals played an important part in the opacifying action of the fluorides.

As the mechanism of opacifying of enamels and glasses by fluorides seems to have been explained only to a limited degree heretofore, the progress of the above experiments in the course of events led to an investigation of the nature of the crystals which acted as opacifiers.

This was first done by examining the melts by usual crystallographic means. It was found that these methods of investigation were not sufficient to identify all the substances causing the opacifying phenomena and consequently in a special series of tests X-ray methods were applied, these bringing about a complete solution of the problem.

In preparing the experimental melts losses of fluorine occurred to a marked degree such as also have an important effect on technical melting operations. As this problem has hitherto remained obscure it was attempted to clarify this also by a special investigation.

1. Examination of the Literature.

The addition of fluorides to batches for opaque glasses, particularly for milk glass for illuminating purpose and as an opacifying agent for enamels is very common at present. In the latter case it is used particularly to intensify the effect of "true" opacifiers such as tin oxide, zinc oxide, sodium antimoniate, etc. To a secondary extent fluorine compounds are added to alter the physical properties of glasses such as fusibility, elasticity, thermal expansion, etc.

The sources of fluorine ordinarily available are fluor-spar, cryolith, sodium silicofluoride, aluminum fluoride, and sodium fluoride. They are added to the glass by mixing with the raw material and melting in the glass furnace along with the glass batch.

The problem of how the addition of fluorides causes the opacifying action has been investigated to a considerable extent. One of the oldest investigations of the problem of the mechanism of opacifying by fluorides is that of Benrath[1]* He ascribes the whitening effect of cryolith to the precipitation of alumina and he bases his conclusion on the observation that alumina does not dissolve in melted fluorine compounds—he mentions sodium fluoride.

Encquist[2], on the other hand, considers the opacity as due to fluorine gases which are entrapped on the solidification of the glass. He offers as support for his conclusion that high temperature and too long a melting lead to a weakening or even a disappearance under certain conditions of the opacifying effect.

In an article by Bock[3] the opinion is advanced that in a melting operation carried out technically correctly the total fluorine content would be given off as silicon fluoride. He assumes that the fluorides act principally as fluxes and that they have only a minor value as opacifying agents. As the true cause of opacifying phenomena Bock also assumes the precipitation of certain components of the melt such as, for instance, alumina.

Vondracek[4] believes the separation of aluminum fluoride to be the cause of the opacifying action of cryolith. He believes that the part of the fluorine in the cryolith which can be assumed to be united to the aluminum precipitates out as such and exerts an opacifying effect, while the fluorine united to the sodium reacts with the silica present to form silicon fluoride and is lost. It is obvious that Vondracek assumes cryolith to act according to the formula $3(NaF)AlF_3$. In this article several of the older patents are quoted dealing with claims for the use of fluorine compounds.

R. D. Landrum[5] assumes bubbles of water vapor to be the active opacifying agent.

A review of all the possibilities which may be offered for a explanation of the opacifying effect of fluorides is given by J. B. Shaw[6]. He offers the following, without, however, adducing experimental support:

"The opacity is produced:

1. By silicon fluoride gas, SiF_4, which goes into solution in the glass when hot and is precipitated out and held in suspension when the glass cools.

*From Zeitschrift fur angewandte Chemie, May 12, 1927.

*Note: The figures in the text refer to the references given at the end of the article.

2. By SiF_4, not by the gas itself, but by some characteristic crystalline structure which the glass is caused to assume by the SiF_4.

3. By the formation of sodium silicofluoride, Na_2SiF_6 or the precipitation of Al_2F_6.

4. By precipitation of alumina, Al_2O_3, all F being evolved as SiF_4."

Esch[7] believes himself justified in arriving at the following conclusions in an article on fluorine-containing opacifiers: The opacity arising in glasses treated with fluorides is due to various causes:

1. The separation of sodium silicofluoride.
2. The crystallizing out of aluminum oxide or aluminum silicate.
3. The inclusion of bubbles of silicon fluoride.

The possibility of opacifying by separation of aluminum fluoride is discarded by Esch.

Schulz[8] and Henze[9] assume a gaseous subdivision of the fluorine compound used in the melt which precipitates out on solidification of the glass. In an article by Otremba[10] the opacified glasses are investigated microscopically and described. Otremba melted various series of enamels with various amounts of fluoride additions. All the batches were "burned" at 740°C and 950°C (1364°F. and 1742°F.) and the two types of product thus obtained were examined. The composition of the melts is given only in the form of the raw material batches used and not as analyses of the finished product.

In order to indicate the type of enamel investigated two of Otremba's batches and their approximate (calculated) synthetic composition is given herewith.

Mixture A_1	Calculated Composition	Mixture E_2	Calculated Composition
39.0 quartz	48.9% SiO_2	37.4 quartz	47.1% SiO_2
39.5 borax	18.2% B_2O_3	35.3 borax	16.3% B_2O_3
4.6 soda	11.7% Na_2O	5.3 soda	19.1% Na_2O
17.0 fluor-spar	21.3% CaF_2	17.4 saltpeter	17.5% cryolith
	(10.4% F)	13.9 cryolith	(9.5% F)

Otremba prepared thin sections of the solidified melts, illustrations of which are given in his article. In the enamel opacified by flour-spar Otremba observed chiefly crystalline dendritic deposite together with very small particles of irregular form. In the glasses containing cryolith he thought he was able to observe that the opacity was due to very tiny bubbles arising from the evolution of the fluorine as such and as silicon fluoride. He describes the condition thus:

"The crystals also present here are resolved into tiny bubbles which permeate the entire melt. It results from this that the formation of crystals is to be ascribed to the presence of fluorides. If the crystals are disturbed no further formation of bubbles can occur and as these are given off transparency results." Speaking of melts opacified by cryolith he says: "It is not possible to determine whether the opacity is due to bubbles, but numerous dark points can be recognized. It may be concluded that the evolution of gas is completed and that in this case fluorine has entered into a state compound (or into one decomposable at higher temperatures only) with another element." The opacity caused by sodium silicofluoride in his opinion is similar to that caused by synthetic cryolith: "It consists," he says, "as in the case of cryolith, of tiny opaque points which are completely surrounded by minute crystals. In one place it can clearly be seen how this opacity has come about. The sodium silicofluoride is seen to be still undissolved. The crystal formation proceeds from it and at larger intervals the crystals accumulate and are dissolved to produce the opacity which again consists of minute crystals."

Otremba considers it probable that the fluorides are decomposed to aluminum and alkali fluorides in the melt as the content of alkalis and aluminum oxide of the batch seems to have an important effect on the intensity of the opacifying action. He notes also that fluorspar makes the batch more difficultly fusible, so that under the conditions prevailing it can hardly be considered as a flux.

Vielhaber[11] in discussing Otremba's work assumes the formation of sodium fluoride from the added fluorides and from the silicon fluoride evolved acting on the sodium oxide of the melt, or a formation of aluminum fluoride or aluminum silicofluoride with aluminum oxide according to the following equations:

$$Na_2SiF_6 + 2Na_2O = 6NaF + SiO_2$$

$$SiF_4 + 2Na_2O = 4NaF + SiO_2$$

and $2Na_2SiF_6 + 2Al_2O_3 = 4AlF_3 + 2Na_2O + 2SiO_2$

or $3Na_2SiF_6 + Al_2O_3 = Al_2(SiF_6)_3 + 3Na_2O + 3SiO_2$

No attempt to prove the occurrence of the reaction was made.

2. Microscopic Investigations

While the question whether fluorides actually exercise an opacifying action has been answered satisfactorily in the affirmative from experimental data, there are, as the literature cited shows, conflicting views as to the manner in which fluories act as opacifiers.

The views quoted may be arranged in three classes. It may be assumed that the opacity is caused by:

1. Crystallized components of the vitreous mass.
2. Included gas bubbles.
3. Fluorides in the form in which they are added to melt or ah reaction products.

The separation of components of the vitreous mass in the presence of fluorides is not to be dismissed off-hand; it would represent a sort of devitrification. The assumption appears obvious, for together with other compounds the fluorides play a part in silicate chemistry in a mechanism which has been but little investigated, namely, as mineralizators. These compounds exercise their specific effect by increasing the number of centers and velocity of growth of crystals, in which phenomena

it is still an open question whether the effect is due to a decrease in internal friction of the melts and consequently an increased mobility and increase in particle size.[12]

In the case of silicate melts the solidification products are influenced to an important extent by factors other than in the case of salts and metals, where we generally deal with easily recognizable equilibria. For instance, viscosity and the tendency to super-cooling play an important part. But opposed to the above viewpoint is the fact that the glasses used as enamels and glazes without exception contain a high content of alumina and boric oxide and that both of these components do not exercise a devitrifying action. If the fluorides actually operated only as mineralisators their influence would necessarily be very marked; but this is improbable in view of the relatively short time for which the technical melts are subjected to higher temperatures and in view of the fact that the glasses under consideration show but little tendency to devitrification.

Besides, in the case of silicate melts, we are dealing with systems containing relatively large numbers of components. Their composition varies very strongly from that of the minerals which could be formed. We might, therefore, reasonably expect a considerable lowering of the melting point, that is to say, a lowering of the crystallization temperature of these minerals. It must be remembered, however, that with falling temperatures a considerable increase in the viscosity of the melts occurs. The fact is that high alumina glasses are difficult to devitrify. Vogt[13] explains the anti-devitrifying action of alumina on the basis of the line of thought delineated above, on the one hand as due to a lowering of the crystallization temperature and on the other hand as due to the simultaneous increase in viscosity of the melts resulting from the addition of alumina.

The second viewpoint as to the opacifying action of fluoride additions (that opacity is caused by the inclusion of gas bubbles) has been widely defended most recently by Otremba[10] on the basis of the observations of his thin sections.

The fundamental assumption of the formation of silicon fluoride in fluorine-containing silicate melts makes possible the conclusion that gas inclusions are the cause of the phenomenon. It is, however, improbable that the intensive working of the melts required in technical operations would permit the uniform distribution of bubbles of the same order of magnitude as would be required in the case of a resultant opacifying effect. This viewpoint seems to have been taken into consideration in the hypotheses of those investigators who assume the formation of alkali silicofluoride as the cause of the opacity effects. But this reaction seems to be excluded as the salts of hydrofluosilicic acid are extensively decomposed by heat, e. g.,

$$Na_2SiF_6 = 2NaF + SiF_4$$

In this class belongs Shaw's[6] hypothesis. He offers for discussion the opinion that opacity is caused by a "crystalline structure of the glass induced by the action of SiF_4." What he specifically means is not clear from my results; as he cannot mean an etching effect, it must be assumed that Shaw refers to the above mentioned reaction and precipitation.

The third group of hypotheses relates to the direct opacifying action of the fluorides. Along this line there have been conclusions dealing with the formation and precipitation of silicofluorides. That this assumption is highly improbable because of the instability of these compounds at higher temperatures has already been pointed out.

Greater attention is merited by the assumption of the precipitation of sodium fluoride, aluminum fluoride or other fluoride additions originally added to the solidifying melts. Experimental researches along this line are not available with the exception of Otremba's[10] work mentioned above. He does not make a definite decision, but Vielhaber[11] uses his results to support the hypothesis of the formation of sodium fluoride and aluminum fluoride through the intermediate action of silicon fluoride. Vondracek[4] assumes in the use of cryolith as opacifying agent the separation of the aluminum contained in this compound as aluminum fluoride while the rest of the fluorine is evolved as volatile silicon fluoride. However, such an action of cryolith hardly agrees with its other properties as the soduim salt of hydro-alumino-fluoric acid; this assumption is, therefore highly improbable. Besides it was found as is shown later that aluminum fluoride shows greater losses of fluorine than sodium fluoride which is in direct disagreement with Vondracek's assumption.

To decide these questions there was in the first place the possibility of the microscopic examination of specially prepared melts. A total of about 50 melts was investigated most of which were prepared by adding sodium fluoride. A smaller number were examined which were melted with cryolith, calcium fluoride and aluminum fluoride. The opaque glasses numbered I and II in the attached tables were prepared on a small scale in an electric furnace; the melts numbered III were prepared in quantities of 400-600 grams in a gas-fired pot.

The average composition of the products considered approximates—with certain exceptions—that of "powder-enamels." This type was selected as the present investigations arose from various problems met with in the enamel industry and, besides, the "powder-enamel" was selected so that the most homogeneous type of composition might be investigated.

The powder-enamels are ground to a fine powder after fusion and are then applied directly to the iron surface to be enamelled. On the other hand wet enamels—and this is the type principally used

in practice—are in the form of a paste made by mixing with water and contains besides the opaque glass mill-additions like quartz, alumina and opacifiers and are melted onto the iron. The latter under the microscope after the enamelling process are quite inhomogeneous and the greater part of the additions can be observed microscopically as undissolved. In this manner the investigation of wet-enamels is complicated without taking into account the variations in the basic glass under consideration.

A review of the composition of the raw materials used for the various melts is given in Table I; Table II gives the composition of the melts in percentage by weight calculated from the raw material batches; Table III is so arranged that the sum of the molecular percentages of the fundamental glass composition is 100 and the molecular percentages of the fluoride used are calculated relatively to the fundamental glass composition. In Table 4 the conditions under which melts I and II were made are shown.

The glasses numbered I and II are characterized by short fusion periods corresponding to commercial operating conditions and under the microscope are similar to commercial melts. Those numbered III were fused for considerably longer periods of time and show distinct structural differences from the former. They were primarily prepared so that precipitates might be increased in size to the point of satisfactory observation.

Melt II-5 was heated at 800° C. for 30 minutes.

Melt II-9 was heated at 800° C. for 6 hours.

Melt II-26 was heated at 750° C. for 5 hours.

Melts I and II were heated partially in platinum and partially in porcelain crucibles. The latter were not appreciably attacked by the melts. A vertical electrical resistance furnace with a wide tube was used as the furnace. The temperature was measured at the outside of the crucible at the center of the depth of the charge, a platinum: platinum-rhodium thermoelement was used. At the end of the fusion the crucible contents were poured into a large silver spoon in which the charge quickly solidified to a glassy substance in the form of drops, in some cases clear, in other cases opaque. The internal stresses resulting from this forced chilling were released on further cooling, but also partially by a subsequent reheating in which the mass broke into several pieces with great force.

Part two of this article will appear in the next number.

TABLE I

Conditions of Preparation of Melts I and II

	Melts	Time of Fusion Minutes	Melting Point Degrees C.	Type of Crucible	Appearance After Chilling	Temperature of Initial Opacity on Reheating Degrees C.
I	1	65	1130	Platinum	Opaque	...
	2	60	1140	Platinum	Clear	675
	3	70	1110	Platinum	Clear	Indefinite
	4	60	1130	Platinum	Clear	650
	4a	60	1130	Platinum	Clear	635
	5	55	1130	Platinum	Clear	Indefinite
	6	45	1130	Platinum	Clear	Indefinite
	7	60	1130	Platinum	Clear	585
	8	75	1130	Platinum	Opaque	...
	9	45	1130	Platinum	Clear	Indefinite
	10	60	1080	Platinum	Clear	555
	12	60	1065	Platinum	Clear	555
II	1	60	990	Platinum	Opaque	...
	2	60	980	Platinum	Opaque	...
	3	60	1010	Platinum	Clear	565
	4	60	1030	Porcelain	Opaque	...
	5	60	990	Porcelain	Clear	755
	6	60	990	Platinum	Clear	640
	7	60	1000	Porcelain	Clear	Indefinite
	8	60	1010	Platinum	Opaque	...
	9	60	1010	Porcelain	Clear	645
	10	60	1000	Platinum	Clear	530
	11	75	1020	Porcelain	Clear	770
	12	60	1030	Porcelain	Clear	675
	13	60	995	Porcelain	Opaque	...
	14	45	980	Porcelain	Opaque	...
	15	105	980	Platinum	Opaque	...
	16	40	980	Porcelain	Clear	580
	17	60	1010	Platinum	Clear	610
	18	70	980	Porcelain	Opaque	...
	19	45	1010	Platinum	Opaque	...
	20	75	1000	Porcelain	Opaque	...
	21	45	1020	Porcelain	Clear	630
	22	75	1010	Porcelain	Clear	590
	23	60	1010	Platinum	Opaque	...
	24	55	1010	Porcelain	Clear	560
	25	60	990	Platinum	Clear	575
	26	60	990	Porcelain	Clear	510

PIT AND QUARRY FOREIGN DIGEST

New German Stone Machinery

Figure V shows a crusher consisting of a double roller studded with spines. Figure VI is a feldspar

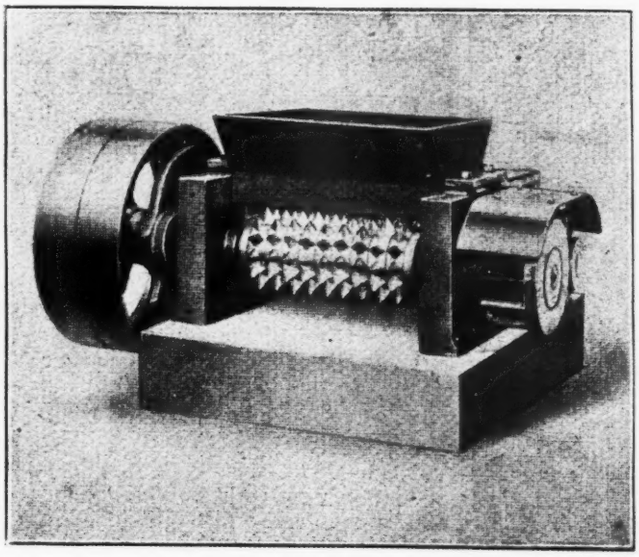


Fig. 5

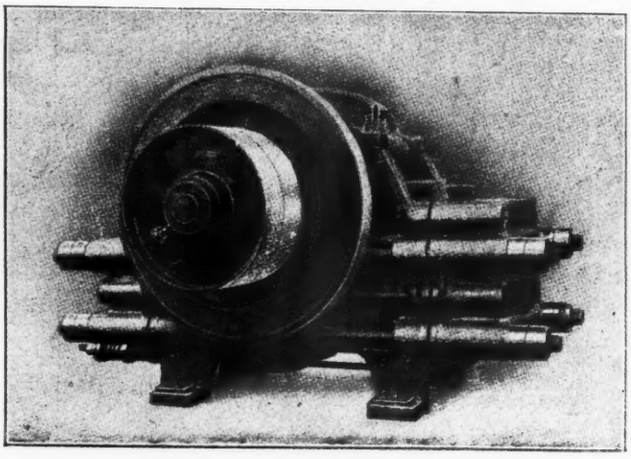


Fig. 6

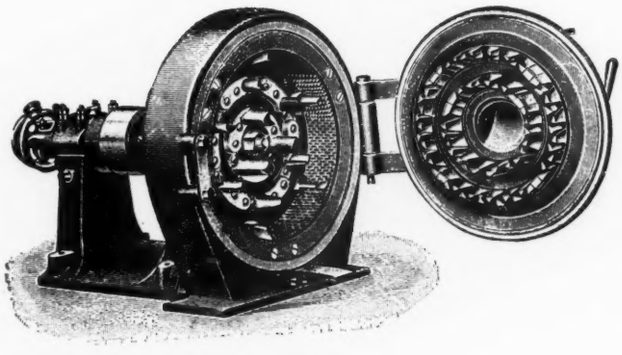


Fig. 7

crusher, Soest system. Figure VII is a circular toothed mill, open. Figure VIII is a dry tube mill for fine grinding. (Special Correspondence.)

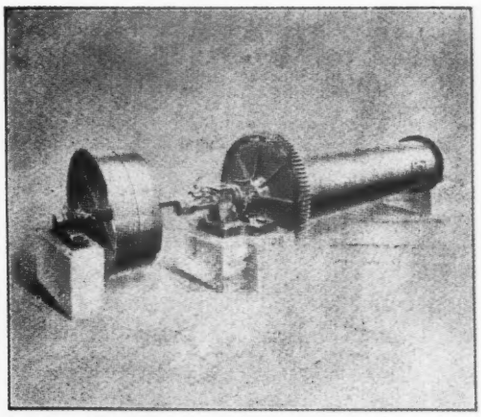


Fig. 8

Retempering Concrete

It has been a well established axiom that concrete must not be "killed," or retempered; i. e., disturbed after setting has commenced. Many faults have been explained by the statement that the concrete "must have been killed," but this idea has recently been shown to be false and that retempering is an advantage in many circumstances. Duff Abrams in the U. S. recommends keeping the mixed concrete 30 minutes to 3 hours before placing. But retempered concrete must not be allowed to become stiff or friable but must be kept continuously plastic until finally placed in position. Also, no more water must be added; if the batch cannot be kept plastic without addition of water, it must be discarded. The value of retempering lies in the more intimate mixing, in more complete hydration of the cement particles, and a more complete absorption of the surplus water by the cement. The factors tend both to increase the strength and to reduce the amount of contraction due to drying. Retempered concrete must be kept continuously moist for a week due to the inevitably slower hardening. Perhaps concrete could be mixed in larger batches for longer intervals with better results. Great possibilities can be seen in the developments of the mixing process. Editor (Concrete & Const. Eng., August, 1927, p. 466-468).

Treating Clay

Clays are boiled with a strong mineral acid which dissolves out the colored ingredients but does not form aluminum salts to any appreciable extent. A fluorine compound is then added. For example, 1 lb. of sulphuric acid, 7 lbs. of yellow clay and 21 lbs. of water. The mixture is boiled until the colored matter is dissolved and the liquid reduced to half its volume, when ½ lb calcium fluoride is added and the boiling continued until the mass thickens. The product contains bleached clay and a product resembling mica. The mixture is treated

by decantation to separate the bleached clay from the mica-like substance. The liquor containing the coloring substances may be treated to obtain compounds of vanadium or uranium, or may be treated to produce blue iron pigments. J. G. Cloke (British Patent 272, 976).

Influence of Water on Reactions in the Solid State

Reactions in the solid state occur in the ceramic and cement industries at high temperatures, but the influence of water on such reactions is variously interpreted. One idea is that water on the surface

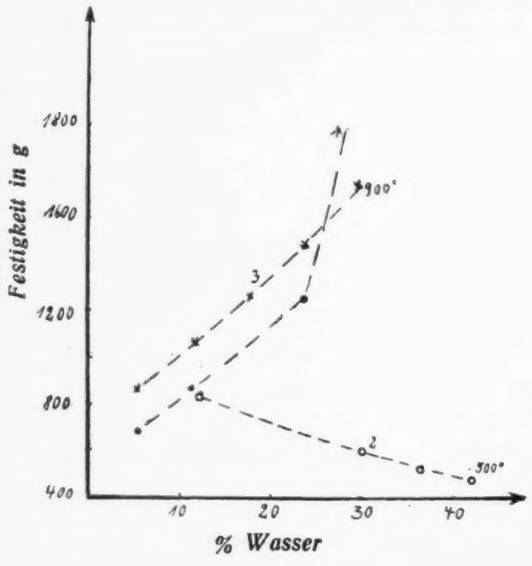


Fig. 1

of the powder is the initial cause of these reactions. Water may be absorbed by metallic oxides such

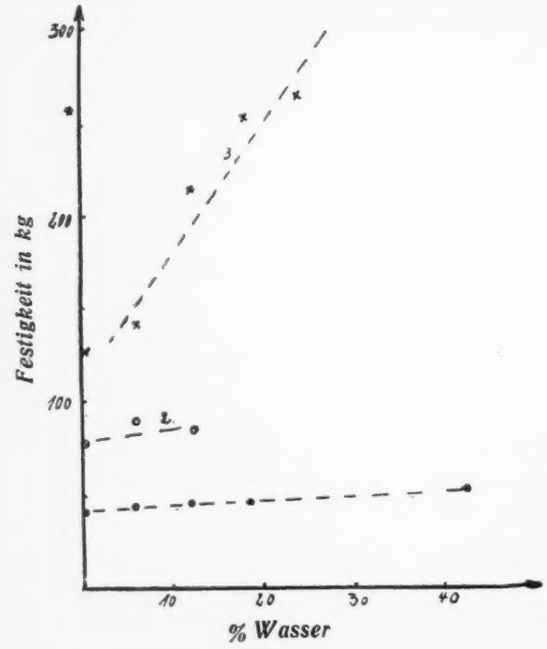


Fig. 2

as barium oxide or lime, and the resulting hydroxides, melting, as they do, at lower temperatures than the oxides may initiate the reaction. But not only does water play a part in the reactions of several components, but, due to recrystallization, the powder of one single substance reacts with

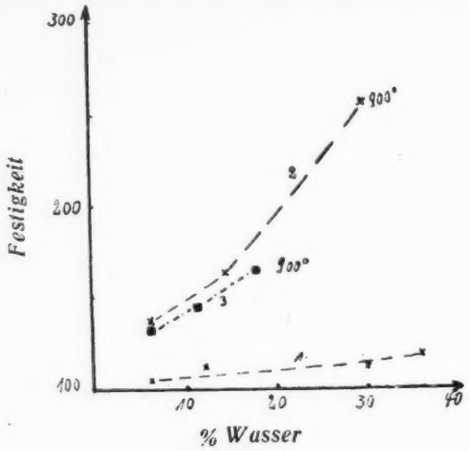


Fig. 3

water, resulting in an increase of strength. Small pellets were prepared with quartz powder under pressure and with water content varying from 6 to 36%. The strength was determined before and after heating to 500 to 900 degrees C. The strength increases in the unheated pellets with increasing water content. By heating to 500 degrees the strength decreases with increasing water content, but when the pellets are heated to 900 degrees C., the strength increases with mounting water content. These relations are shown in Figure 1 (Festigkeit in G = Strength in grams, wasser = water). Figure II shows the relations for calcium carbonate and water. In this case the heating in the presence of water makes a great difference. The strengths here are shown in kilograms. Curve 1 refers to the unheated material, curve 2, heated to 500 and curve 3, heated to 900 degrees C. Figure III shows similar relations for alumina. Bernward Garre (Zement, August 4, 1927, p. 658-660).

Rapid Hardening Cement and Cold Water

A series of tests were made with rapid hardening and ordinary Portland cement. They were first compared under standard conditions for setting time, tensile and crushing strengths at various intervals, and these values formed the basis of comparison for a series of tests at low temperatures. The test pieces were prepard in a room the temperature of which was 6-7 degrees C.; they were allowed to set in an ice cooled zinc box at a temperature of 3-4 degrees C., and then allowed to harden in ice water. The setting time and the beginning of the hardening were very much retarded by the low temperatures, but after 28 days the difference in strength of the pieces hardened at low temperatures and at ordinary temperatures is slight and unimportant.

INTIMATE NEWS OF MEN AND PLANTS

New Stone Plant Opened

The F. A. C. Crushed Rock Corporation have opened up a new crusher plant at their quarry in the Murphy Canyon, near San Diego, California. The new plant will have a capacity of 150 cubic yards every eight hours and presents several innovations in construction and operation in that part of the country. One of the novel features of the $40,000 plant is the arrangement of the crusher so that the sand and finer material, which frequently clogs the crusher, passes around the machine, while the larger rock goes through the crusher and the two materials unite beyond to be conveyed to the washing plant and revolving screens.

Charles W. Walters Passes

Charles W. Walters one of the well-known men in the stone producing industry, died in Cleveland on August 22. Mr. Walters was a native of Chicago and was in business there for a number of years. He was president of the Cleveland Stone Company and had been identified with the Indiana Oolitic limestone industry almost from its inception. He was chairman of the executive committee of the Indiana Limestone Company at the time of his death.

New Lime Plant For Ohio Under Construction

The National Lime and Stone Company is erecting a new lime plant near Carey, Ohio, to take the place of a more antiquated one nearby. The company owns eight stone production plants at some half dozen points in the state of Ohio.

Surveys N. C. Resources

A survey of the resources and industries of North Carolina as a part of the work of the state Department of Conservation and Development, to encourage the development of opportunities afforded by the state, has been started under the direction of Park Mathewson, well known statistician. Mr. Mathewson was formerly head of the Budget Bureau of New York City.

The plan is preliminary to exploitation of the states' advantages for industry and new capital. It was thought that, before attempting any exploitation, through direct or indirect advertising a survey of the natural resources of the state should be made in order that the advertising might carry genuine information to the prospective industries.

East Quarry Company Adopts Employee Insurance

Through cooperation with their employer, approximately $100,000 of group life insurance has been established for the employees of the East Quarry Company, of Glencoe, Alabama. The contract besides the life insurance, provides for the payment of liberal sick and accident benefits.

Under the schedule of insurance benefits, each subscribing employee receives $1,000 life insurance, and payments of $7.50 a week through the health and non-occupational accident policy. These weekly benefits will continue in each case of disability, for a maximum of twenty-six consecutive weeks.

Industrial Sand Moves

The Industrial Sand and Gravel Corporation have just completed the transfer of their general offices from Lawton, Oklahoma, to the plant at Cache, Oklahoma. The office will be under the supervision of A. L. Marshall, plant superintendent.

Install New Slurry Tanks

Superior Portland Cement Inc., has started the erection of six new slurry tanks of reinforced concrete construction. Each of the tanks will be thirty-eight feet in diameter and about thirty feet high and will have a capacity of 3000 barrels, giving the company an additional capacity for mixing slurry of 18,000 barrels. The company already has in use six tanks of about the same size.

New Pacific Coast Plant

One of the most modern sand and gravel plants in the country has been completed in the Otay Valley, about three miles east of the town of Otay, California, by the Spreckels Commercial Company. J. E. Stanley is general manager.

The plant itself occupies a thirteen acre site but the company owns or has leases in the Otay wash averaging 600 feet wide and seven and one-half miles long. The deposits of sand and gravel in this location are estimated to be sufficient to supply all the needs of a city of the size of San Diego for 100 years, according to G. A. Roalfe, engineer in charge of the design and construction of the plant.

Gravel, sand and crushed rock are put out at the rate of 1,500 tons per day of eight hours and as the plant is entirely electrically operated but eight or nine men are required to operate it.

New Incorporations

The Commonwealth Portland Cement Corporation has been organized in Philadelphia with a capital stock of 27,000 shares of no par value to conduct a general cement lime and concrete business.

The Concrete Service Company has been organized in Birmingham, Alabama, with a capital stock of $10,000.

F. A. C. Crushed Rock Corp., Murphy Canyon, San Diego, Calif., owned by S. W. French, A. Anderson and J. A. Corriere, $40,000.

Casey Lime & Stone Co., Casey, Ill., $16,000. J. W. Etchison, F. L. Chrysler, Walter A. Newlin.

Clearwater Sand & Shell Co., Inc., Clearwater, Fla., $25,000. Edward N. Eaton, A. H. Zimmerman.

New Mexico Onyx Quarries Find Eastern Market

New Mexico onyx mines, said to be the best properties of their kind in the United States for commercial purposes and which have been entirely financed by local capital are finding a good market in the east. From $4,000 to $5,000 is the price being quoted for a carload of 30 tons. The onyx is mottled and banded in various colors. It is used for fancy interior decoration when possible to cut in the larger sizes.

Pacific Portland Plant Will Be Rebuilt

The Plaster City mill of the Pacific Portland Cement Company, one of the largest mills in California, which was totally destroyed by fire a few weeks ago, will be rebuilt at a cost of $150,000, according to late reports. The crusher, storehouses and offices were not damaged by the fire. The plant employs about 100 men.

J. E. Griffith to Portland

J. E. Griffith, who has been in charge of the construction of a cement plant at Fort Collins, Colo., has been selected as superintendent of the cement plant at Portland, Colo., succeeding E. J. Strock.

Richard Hardy, Chairman of the board of directors of the Pennsylvania-Dixie Cement Company, died recently.

Nickolas M. Duncan, Chairman of the board of directors of the Marquette Cement Manufacturing Company died in the latter part of August.

New Cement Plant Planned

The American Portland Cement Company is the name of a company which has been organized by a group of Los Angeles men to engage in the business of manufacturing building material. The company has taken over the sole rights for South California for what is known as the Houghton building construction process. The company, capitalized at $2,500,000, was organized under the laws of Delaware. Shares of a par value of $1 each are nonassessable. The board of directors is composed of Briant S. Young, Max O. Miller and U. J. Rogers.

Holdings of the company at the present time consist of 680 acres at Cajon pass, San Bernardino County, where it is estimated, the company has a supercial area deposit of 22,000,000 tons of lime, and 3,000,000 tons of cement clay on the surface. The company contemplates installing an initial unit of 2,000 barrels a day capacity.

President Young, in commenting upon the Houghton building construction process, says: "Under this process we will manufacture at our mill this building material, stated to be the best of its kind anywhere. The material is made from cement in various colors, with an interlocking device that automatically builds without the necessity of forms, and will include a building in its entirety, floors, walls and fireproof and weatherproof roofs. All material will be fabricated by a plant to be installed by us under license of letter patent issued to the inventor."

Production of Clay In 1926

The quantity of clay sold by producers in the United States in 1926 amounted to 3,966,313 short tons, valued at $14,102,505, or $3.56 a ton, according to a statement made public by the Bureau of Mines, Department of Commerce. These figures show a decrease of 2 per cent in quantity and an increase of 11 per cent in value compared with 1925. They represent only clay sold as clay or mined under royalty and do not include the much greater quantity of clay that was burned into clay products by the producers themselves from their own property. The data were collected direct from producers in 43 States and in cooperation with the State Geological Surveys of Alabama, Florida, Georgia, Illinois, Iowa, Maryland, Michigan, Missouri, New Jersey, New York, North Carolina, Texas, Virginia, Washington and Wisconsin. The leading five States in the order of the quantity of clay sold were Pennsylvania with 22.6 per cent of the total quantity, Missouri with 11.6 per cent, New Jersey with 8.6 per cent, Ohio with 8.5 per cent and California with 7.5 per cent.

The sales of kaolin, the clay that is used in making high-grade pottery and porcelain, as well as paper, oilcloth, and other products, and which is generally considered the highest grade of clay, amounted to 432,215 tons, valued at $3,771,568, an increase of 18 per cent in quantity and 17 per cent in value as compared with 1925. The clay of largest quantity and value is fire clay. The sales of fire clay in 1926 were the largest ever recorded—2,815,961 tons—and were 10 per cent greater than those of 1925, the year of largest output previous to 1926. The value of the fire clay sold in 1926 was $8,111,239, an increase of 11 per cent as compared with 1925. The sales of clay of every kind, except miscellaneous clay, increased in quantity and value in 1926 as compared with 1925.

Car Liner Reduces Losses

Producers in the Pit and Quarry field will be pleased to learn that the Hummel Ross Fibre Corporation has been devoting special attention to the problem of reducing losses through lining cars before shipment with a sulphate Kraft paper. In cases where the product is shipped in sacks or bags losses occur through tear from nails, projection, etc., in the car during loading and transportation. In instances where material is shipped in bulk, losses occur through leakage principally. These losses assume large proportions during a season's shipments. To eliminate these losses the use of Hopewell Kraft paper liner is recommended by the Hummel Ross Fibre Corporation.

This company manufactures a car liner extremely light in weight that can be supplied in rolls containing just enough car liner to line a car. This car liner is made entirely of sulphate Kraft pulp which is the strongest wood pulp in the world.

D. H. Fair, formerly connected with the Geo. Haiss Mfg. Company at their New York office has been made district representative of the company in the Great Lakes district.

Coast Cement Plant Second In Safety Award

A first aid team of five men from the Redwood City Plant of the Pacific Portland Cement Company won the second place in a first aid contest sponsored by the California Association of Safety Engineers at the Palace Hotel in San Francisco recently. This was the first attempt of the team in a contest, and as they were competing against some of the best teams of the state their performance is considered exceptionally good.

The five men representing the Redwood City Plant were Harry Stevens, captain; Jim Hunt, E. J. Halcrow, John Talkington, Tim Rider and William Norton, who acted as patient.

The teams competing in the contest in the order in which they were adjudged were 1, P. G. & E., San Rafael; 2, Pacific Portland Cement Co., Redwood City; 3, Standard Oil, Richmond; 4, Standard Oil Co., San Pablo; 5, Associated Oil; 6, Portland Cement Co., Cement; 7, Cowell Cement Co., Mt. Diablo; Union Oil Co., Mt. Diablo; Union Oil Co., Oleum.

The meet in the city was a preliminary contest for the state contest to be held in Los Angeles next month.

The Wade Engineering Company of Los Angeles, California, distributors of the products of the Lincoln Electric Company, have moved their northern office from 69 Webster St., Oakland to larger quarters at 533-539 Market St., San Francisco.

Natural Abrasives in 1926

The total quantity of natural abrasives sold by producers in the United States in 1926 was about 225,000 short tons, valued at over $4,500,000, according to a statement compiled by the United States Bureau of Mines, Department of Commerce, from individual reports furnished by producers. In addition, there were manufactured and sold during the year 73,603 short tons of artificial abrasives, valued at $6,751,165, divided as follows: Carbides, 17,026 short tons, valued at $1,702,037; aluminum oxides, 43,967 short tons, valued at $4,106,699; and metallic abrasives, 12,610 short tons, valued at $942,429.

Natural Abrasives Sold by Producers in the United States, 1925-26

Abrasive	1925 Short tons	1925 Value	1926 Short tons	1926 Value
Diatomaceous earth	73,030	$922,281	87,126	$1,081,564
Emery	769	5,907	386	3,641
Garnet	8,429	712,853	6,397	523,875
Grinding pebbles and tube-mill lining	3,831	50,147	6,219	85,146
Grindstones	28,970	864,637	28,669	875,240
Millstones, chasers and dragstones	(a)	22,490	(a)	45,937
Oilstones, whetstones, hones, scythestones, and rubbing stones	970	272,224	1,640	218,359
Pulpstones	8,370	841,302	9,670	997,994
Pumice	40,380	179,020	53,887	208,504
Tripoli	29,388	434,886	31,369	523,609

NEWS OF EQUIPMENT MANUFACTURERS

Variable Speed Transmission Simplified

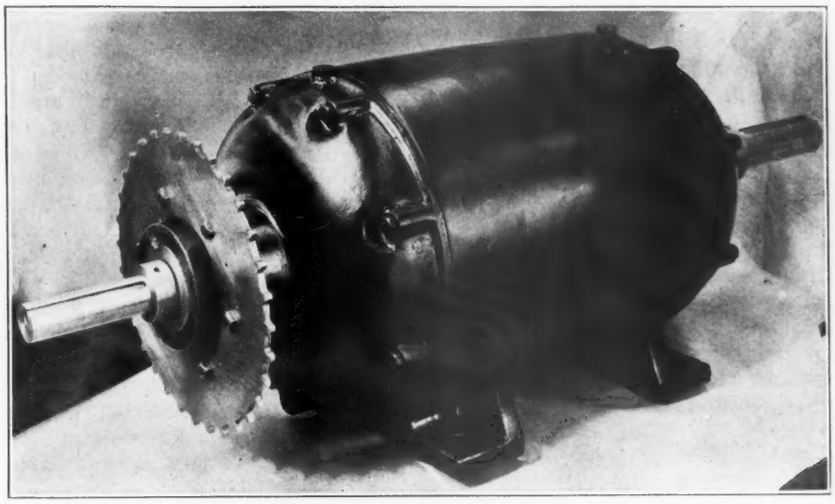
Unusual interest has been concentrated on the J. F. S. variable speed transmission announced by Stephens Adamson Manufacturing Company. It is a simple yet effective mechanism which fills a definite need for variable speed drive requirements. With this equipment constant speed, high speed motors which are economical to purchase may be used to drive machinery and the JFS variable speed transmission if incorporated in the drive will provide variable operating speeds over a wide range.

There are many classes of equipment which, because of their work and their characteristics, necessarily must be driven at varying speeds. In cases, for instance, where temperature and rate of operation must be definitely related, it is essential that means be provided for regulating the rate of rotation. This JFS variable speed transmission performs the function of receiving power at high speeds and delivering that same power at lower speeds for the direct operation of machinery equipment to which the unit may be attached. The rate of rotation of the low-speed shaft may be decreased or increased over a wide range, under absolute control.

The ingenious application of an entirely new principle has resulted in this variable speed changing device which operates quietly, efficiently and without vibration. Here are roller bearings in the new role of transmitting power at a variable rate of speed. The actual transmission of power is accomplished through the resulting action of genuine roller bearings revolving in polished races, submerged in oil. The pressures between the rollers and races of JFS transmissions sufficient to transmit their rated horse powers are only a fraction of the allowable unit pressures common to the usual ball and roller bearing loadings. The hand or sprocket wheel is easily turned to adjust the rate of rotation of the low-speed shaft to any speed within the range.

Variations in speed are made without interruption while the machine is in motion. The machine may be driven in either clockwise or counter-clockwise direction with the same efficient results. The standard variable speed transmissions are made in sizes to transmit ½ to 15 horse power at maximum reduction. There are two distinct series of these machines. The first series provides a reduction of approximately 8 to 1 for the lowest speed. The second series provides a reduction of approximately 40 to 1 for the lowest speed. Each of the series has a variable range of approximately 5 to 1, as is shown in the following examples:

The series "R" transmission directly connected to a 1200 r.p.m. motor will furnish power at any speed from 150 r.p.m. up to 750 r.p.m. The series "RG" transmission directly connected to a 1200 r.p.m. motor will furnish power at any speed from 30 r.p.m. up to 150 r.p.m. The manufacturer has tabulated schedules which give the horse power of each individual machine over its entire range of speed variation.



The J. F. S. Variable Speed Transmission Unit

An interesting and exceptional use of this machine is cited by the manufacturer in describing the application of power to the shaft at the opposite end of the machine. The transmission is changed from a reducer to a machine which increases the input speed and transmits the power over a wide range of variation.

New Dorr Service

For the purpose of giving its customers specialized assistance in connection with the installation and initial operation of its equipment, the Dorr Company have established a service department which will be in charge of Mr. H. A. Linch.

Mr. Linch, who has been associated with the Dorr Company for eight years, has had a wide and varied experience in chemical, metallurgical, and industrial operations, not only in this country, but also in South America and Europe.

Symons Appoints Bodinson

Bodinson Manufacturing Company, Inc., of San Francisco has recently been appointed exclusive agents of Northern California for Symons cone crushers.

The special features of the Symons cone crusher include gravity feed, dust tight mechanism, spring head (permits tramp iron to pass through without damage to crusher), main shaft of chrome-molybdenum steel, other parts ruggedly constructed of manganese and cast steel.

After October 1st the address of the New York office of the Blaw-Knox Company will be Canadian-Pacific Bldg., 342 Madison Ave.

Atlas Conveyor Company Complete Organization

The Atlas Conveyor Company, recently organized, has opened offices at 20 South Fifteenth Street, Philadelphia. Associated with this company will be, Mr. Percival K. Reed, Mr. L. G. Weygandt and Mr. E. A. Thumlert, all of whom were formerly connected with the R. H. Beaumont Company, as Chief Engineer, Eastern Sales Manager and General Manager, respectively. The above company will design and build elevators, conveyors, skip hoists, coal weigh larries, cable drag scrapers, ash hoppers, gates and kindred equipment for the handling and storage of coal, coke ashes and bulk materials.

Prof. H. C. Piffer, head of the School of Chemical Engineering at Purdue University is making investigations to determine a method for removing stains from Indiana limestone

A New Dust Arrester

Any good sized manufacturing plant is usually confronted with a dust problem. Realizing the necessity of taking away the dust from its source in order to protect its workers, most plants have installed piping systems and fans to withdraw dust from within their plants. However, it is no longer merely sufficient to discharge dust outdoors, as it has been clearly shown that disfiguring of plant property and damaging of equipment, due to dust scattered by the winds, is far too expensive. Furthermore, the building of residences and other plants on surrounding property due to the growth of our cities, has made the discharging of dust a nuisance and cause of complaint.

The modern plant executive is demanding a clean shop inside and out and the best of conditions for his men. The question of waste has been more carefully studied and in many cases fine powdered material, which in the past has been blown out in the atmosphere, has been recovered as a valuable by-product.

The use of cloth as a filtering material resulted in the development of two general types of arrestors, one built up of parallel cloth screens having the material rigidly fastened on frames and discharging the accumulated dust by a rapping system; the other by using a number of cloth cylindrical bags usually rigidly fastened at the bottom and suspended from above, discharging the accumulated dust by vibration of the suspension point, or rapping the bags.

In filtering through cloth the friction loss has a definite relation to the ratio of cubic feet of air handled per square foot of cloth area, so that the first type, having a number of screens set closely together, containing a large cloth area, had a decided advantage from the standpoint of space required and expense. However, for the discharging of dust accumulated in the pores of the cloth, which built up the friction resistance and in time unless cleaned, clogged the system, the cylindrical bag type, though limited in cloth area due to space, had a distinct advantage as the cloth bag could be shaken vigorously.

After several years development a distinctive New Haven dust arrestor has been devised, which embodies the best features of both the screen and bag type arrestors with a number of improvements. The added advantage is offered of being able to replace bag units in a few minutes, permitting the maintenance department to keep the arrestor at high efficiency continually throughout its life.

New Booklet on Loaders

The George Haiss Manufacturing Company, Inc., has recently issued a very informative booklet describing their creeper model loaders and also giving some interesting data on loading costs.

After giving detailed specifications of the latest model 27 creeper loaders, the booklet points out that a successful loader must be continuously fed up against the pile or bank, in order to dig full bucket-loads, and must have some device to dig a machine-wide path as it moves into the pile. Haiss therefore designed and patented the revolving-propeller feeding device and the worm-drive, slow-speed-crowding motion which can be operated simultaneously with the bucket elevator. Heavy manganese steel paddles are bolted onto the squared tail shaft of the elevator and revolve all the time the elevator is in motion. The paddles are thick and ribreinforced; the shaft is of special alloy steel and proof against any strains in normal service.

In the use of loaders certain speeds are essential—one for traveling, one for maneuvering into the pile, and one for crowding. The creeper loader was laid out with a special Haiss transmission and clutches designed to give the right speeds with the least effort and loss of time.

The forward speed is 96 feet per minute or 1.1 miles per hour, which is as fast travel as good practice indicates for heavy unsprung equipment. This speed is used for moving the loader and, being the motion away from the pile or bank, is also immediately available for getting away from an avalanche or cave in.

The reverse speed is 65 feet per minute—a speed just right for maneuvering the machine into the pile quickly and spotting it easily.

The feeding device will cut into any gravel bank that a laborer can loosen with a pick. The propellers will dig in light excavation work. In any work they, with the following clean-up scraper, eliminate any need for shoveling in front of or behind the loader. They dig a path 2 feet wider than the machine, ample to permit it to move right through the pile.

The clean-up scraper is a simple device, hung from the elevator but held by thrust members which carry all the strain to the creeper tread axle and not to the elevator.

The scraper is adjustable in its setting in relation to the feeding propellers, the position being governed by the kind of work—below the paddles to prevent their striking concrete floor or paved street, level with the paddles for 100 per cent cleanup, and above the sweep of paddles as circumstances dictate when grading.

The chassis of the Haiss creeper loader is completely braced and the countershafts are all in the transmission box making a rigid unit construction. The slow crowding speed and simple feeding device make it possible to mount the elevator on a rigid pivot shaft carried in bearings on the frames of the chassis. The elevator is well balanced and easily adjusted for feeding level.

The booklet also describes the company's precision hopper and double batch loader and contains interesting data with graphs for determining loading costs.

W. A. Riddell Company Now Controls Three Companies

The plants and business of The Hadfield-Penfield Steel Company, The American Clay Machinery Company, and the Era Steel Company, all of Bucyrus, Ohio, with branch plants at Willoughby and Mansfield, Ohio, have been purchased by the W. A. Riddell Company. The new company is incorporated under the Ohio laws with ample capital and will continue the manufacture of road machinery, clay products machinery, steel castings and other units of the line formerly produced by the predecessors of the W. A. Riddell Company.

W. A. Riddell, president and owner of the Frederick Iron and Steel Co., and president and owner of the Frederick Engineering Co., of Frederick, Maryland, has been made president and general manager of the new organization. Mr. Riddell has an enviable record in industrial management and new aggressiveness will following all activities of the new company. The line of one man graders, crawler tracks for tractors, sand-lime brick machinery, road rollers, scarifiers, rooters and dupat wheel scrapers will be built and added to, from time to time as occasion may justify.

The Manganese Steel Foundry will be continued not only to make manganese steel parts for the Riddell Company equipment but as a contract foundry to produce repair parts for any machinery and equipment and for making steel castings for those machine manufacturersr who have no foundry.

The main offices and plants will remain at Bucyrus, Ohio. The central location of this manufacturing district, the ample plant facilities and the railway connections make Bucyrus an ideal location for manufacturing and prompt servicing of equipment.

A New Power Scraper

The new model of the Miami scraper here illustrated is for use in connection with the model 20-K Cletrac tractor. The illustration shows the scraper and tractor in actual use. This one-man power scraper is exactly what its name implies—a power scraper whereby one man or the tractor driver loads, transports and automatically dumps a full three-quarters yard of earth each and every trip without stopping the tractor. The above is the water level capacity of the scoop pan. The scoop pan can be filled with a full rounded load of earth running from 21 to 25 cubic feet.

It is impossible to stall the scraper for the scoop pan is always under the control of the operator who raises it or lowers it as desired. This control is positive through power winch mounted on the tractor. The positive control of the scoop pan through the power winch enables the driver to dump the load whenever or wherever wanted.

Roller bearing wheel equipment allows the unit to be placed in almost unbelievable positions both for loading and for dumping. After the pan is filled to capacity the driver pushes forward on the lever and raises the pan out of the ground so that the front end is at about a 15 degree angle. In this position the load is transported to the dump on roller bearing wheels with a very slight loss even of a full rounded load. The scraper delivers its pan capacity to the end of the haul each and every trip.

Tanks and Towers Described

A new booklet issued by the W. E. Caldwell Company illustrates and describes this concern's tanks and towers of both wood and steel. Many accessories and fittings such as agitators, friction clutches, gauges, floats, risers, etc. are also described in the booklet.

A wood tank, the booklet states, has certain advantages over any other kind. It requires less care and painting; it gives better protection from freezing and heat and for use with hard or corrosive waters, will last longer than steel. It can be used for holding many chemicals for which a metal tank would be entirely unsuitable.

In the construction of wood tanks the bottom pieces are dressed, ripped, machine jointed and well dowled. The edges are chamfered for the croze or grove in the staves but left a little thicker to allow for possible shrinkage before erecting. A thin shaving must be taken off to make a driving fit with the croze in the staves. The hoops, usually round, are made of wrought iron instead of steel so they will not rust as easily.

An item of particular interest in ths booklet is the tank agitator. These agitators are thoroughly and substantially made and are designed for mixing, stirring and holding in suspension all sorts of solutions and mixtures including dense and plastic materials.

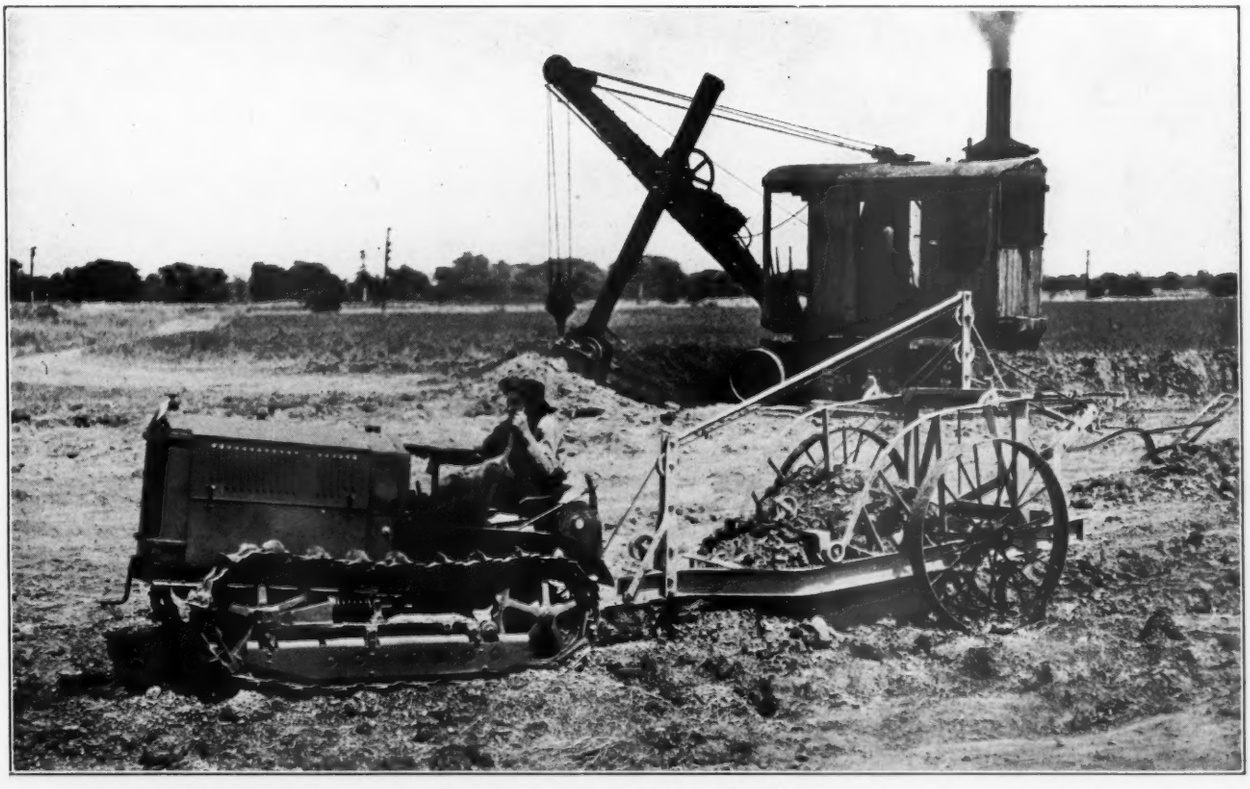
The standard sizes have dimensions of the machinery and other parts proportioned to the diameters and depths of tanks they are used in, assuring the proper strength for all ordinary purposes.

These agitators are made to fit wood or steel tanks.

Standard design consists of steel shafts and winged stirrer arms, heavy cast iron gears, step and toe bearings, anchors and bolts with long-leaf yellow pine millwright timbers across the top of the tank; all framed and finished with all holes bored and bearings set all ready to attach to the tank which any ordinary workman can do even without the blueprints.

Where the substance to be stirred will injure the ironwork, or be injured by it, the vertical shaft and winged stirrer arms are made of wood and the step and toe bearings, bolts, nuts and washers of brass, bronze, duiron or other acid resisting metal.

The standard drive is by tight and loose pulleys. Sprockets or gears may be used or the Caldwell friction clutch attached to a single pulley for easy starting and stopping. This clutch is simple in construction, having only one adjustment, and is especially suitable for this purpose. The speed of the agitators should never exceed 1,000 feet per minute at the ends of the stirring arms but in most cases about one half this speed is ample.



New Power Scraper Unit in Operation

Steel Extension Wheels For Rubber Tires

Where extremely heavy draw-bar pulls are encountered in rubber tired industrial tractor work and where soil and other conditions are severe added traction facilities are many times needed. Take in the instance of highway maintenance work, in the early spring or later during wet seasons, either chains or cleats are advisable.

To meet these demands for positive traction, French & Hecht are now building steel extension drive wheels with cleats that extend partly over the rubber tire on the inside and protrude in the opposite direction from the outer edge of the wheel rim. Especially adaptable are these wheels where heavy pulls are required in cases where ditches are cleaned and made and where extreme grading work is to be done at the side of the road.

Extension Wheel Mounted on Tractor Unit

The diameter of the extension wheels in the same as the outer diameter of the 50-inch rubber tires. The extension wheels are attached to the main wheels in the same way as rubber tired extension wheels, namely, by having lugs through which bolts pass to hold the rims rigidly together and having the hubs machined so that one fits into the other, both hubs being held together by machine bolts. Thus the main wheel and the extension wheel are one unyielding solid unit.

The cleats are made of angle irons having the corners extending outward and are bolted to the extension wheels by three large bolts. These cleats are placed on the extension wheels in the conventional manner and extend partly over the rubber tire. There is an advantage to this particular design, in that the full benefit of the rubber tire is maintained making for easy riding on the part of the operator and at the same time gives the lugs contact with the ground. Penetration is thereby obtained and positive traction assured.

This type of extension wheel with the lugs passing over the rubber tire is now being built in all the various sizes required for rubber tired wheels and will not only fit the McCormick-Deering tractor but all other tractors used for industrial purposes.

Another development that has been made in rubber tired equipment for industrial tractors, especially where used for highway work, are steering bands for the front wheels. These bands are made of steel angle irons and pass entirely around the wheel over the rubber tire being brought up tightly against the rubber tire by a draw-up bolt. In this design one leg of the angle extends outward while the other leg forms the base for the steering band and rests against the rubber tire.

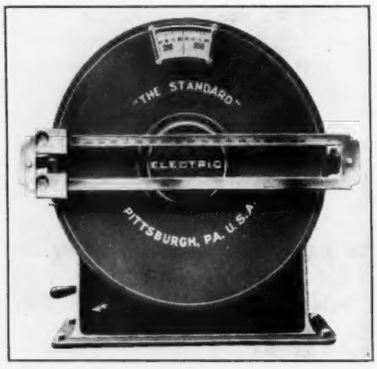
Especially advantageous are these steering bands in cases where heavy duty is required on tractors and soil conditions are such that there is a tendency for the tractors to slip sideways under heavy pulls. These steering bands are adaptable for use on the front wheels on one-man maintainers mounted directly on the tractors. In such cases there is considerable side strain due to the angle of the blade and the steering bands hold the tractors in place on the road. Added traction is gained by the tractor.

This is due to the fact that the tractor is held in a straight position as it goes forward and not diagonally as is true where the wheels slip off to one side. These steering bands are also made for all the various sizes of industrial tractor front wheels.

D. D. Tripp, Vice-President in charge of sales of the Pioneer Rubber Company is making a tour of the Pacific Coast branches of the firm. H. M. Sutherland has left for India to look after the company's business in that country.

New Standard Scale

A new type of electric dial scales has recently been introduced by the Standard Scale and Supply Corporation. This new electric dial scale incorporates the principle of a chemist's laboratory scale, long known for its extreme accuracy, with an electrically operated poise shift which automatically strikes a perfect balance. An accuracy within 1/70 of one per cent can be obtained.



New Standard Scale

The fact that the load on the platform does not do the work of turning the mechanism as in ordinary scales is one of the reasons for its remarkable accuracy. This scale is adaptable to any type of heavy duty beam scale and makes it possible to weigh upwards to 200 loads per hour.

Car Retarder Described

A new circular issued by the Webster manufacturing company describes their car retarder. With this car retarder there is no need for the men to be on the track exposed to the danger from runaway cars due to bad brakes, bad weather and other causes. From a position of absolute security the load trimmer controls the movement of the car under the loading boom or chute. The man on the track with his pinch bar, exposed to imminent danger, is not required. The retarder requires less time and less men and insures well loaded cars without spillage. The car is completely under the control of the load trimmer and can be moved as little as an inch at a time. The capacity of the standard car retarder is 100 tons on 2 per cent grade or one loaded car of 70 tons and one empty car of 30 tons. The retarder is equipped with single brake, ⅝ inch plow steel hoisting cable receiving 4,000 pounds pull under the above conditions. As one cable unwinds the other is winding. There is no overhead structure required, the retarder being a self-contained unit. The capacity of the heavy duty car retarder is 250 tons on 3 per cent grade or one loaded car of 180 tons.

Air Motor Hoists Discussed

In booklet 8120 and circular R-1231 the Ingersool Rand Company describes their air motor hoists and stationary air motors. The newly designed air-motor hoists embody many points not heretofore combined in any single type of hoist, possessing all the essential features which two decades of contact with the field have proved necessary. In addition to this, the hoists have certain novel and distinctive features of their own.

The outstanding characteristics of these hoists are compactness of design, so that but little head room is required; relatively light weight; freeness from vibration and trouble; automatic brakes which positively hold the load under all circumstances, even if the air supply be disconnected or fail, and a graduated throttle control which permits a very close regulation of the lifting and the lowering speeds. The balanced motor operates in either direction and without vibration at any load or any speed within the rated capacity of the machine.

These air motor hoists are built in siz sizes, and have capacities ranging from 500 to 10,000 pounds, respectively. These hoists are designated as sizes A, B, C, D, D6 and E. Size A, with a lifting capacity of 500 pounds, is of a smaller size than has been previously available, and it is admirably suited for a wide range of service. It is used in many industries requiring rapid and economical lifting and handling of small loads, to heavy for one man to deal with. Many concerns find it advantageous and profitable to emply size A hoists on jobs where formerly they relied upon chain, cylinder, or other types of hoisting equipment.

These hoists are counterbalanced, reciprocating, piston-type motors; the A and B sizes have three cylinders and all other sizes four cylinders.

Vibration is removed by equally spacing the cylinder about the crank, by using interchangeable pistons and connecting rods acting on one crank pin, by supporting this single-throw crank between two ball bearings, and by accurately counterbalancing it.

A trouble-free motor is obtained by making all the parts of simple and rugged design; by the use of a strong piston wrist pin construction, solid one-piece drop-forged connecting rods, and a heavy sectional crank; and by providing an unusually efficient splash and force-feed system of lubrication.

The reduction gears of these hoists are all machine-generated spur gears, which are cut from selected materials and then heat-treated whenever necessary to insure an ample margin of strength and wearing qualities. The stub form of tooth has been adopted throughout because of its inherent strength and smooth-running characteristics.

The gear end is completely enclosed. This arrangement excludes all dust and dirt and enables the gears to operate in a bath of oil or semifluid grease. Ball bearings or phosphor bronze bushings are provided at all points where experience has indicated that they will add to the efficiency of the life of the hoist.

A new and valuable feature of these hoists is the brake, which will hold the load at any desired position for any length of time, regardless of air pressure. This apparatus consists of a disc, attached to the motor shaft, and a brake plunger with a friction face, which is held in contact with the disc by springs whenever the hoist is not operating; i. e., whenever the air supply to the motor is cut off either by throttling or otherwise.

When air is admitted to the motor to raise or lower a load, the brake is released by the pressure of the air. This air enters from the throttle through a connecting tube and ports, and acts upon a diaphragm. The expansion of this diaphragm lifts the plunger from contact with the brake disc. When the throttle is returned to neutral, the pressure on the under side of the diaphragm is relieved by the escape of the air through the throttle and the brake is automatically applied. A similar action takes place if the air supply fails.

New Time Delay System

The General Electric Company has introduced a new push-button station for use in preventing the cutting out of motors controlled by a magnetic starter, when there is a brief power disturbance. The station has two push buttons, "Start" and "Stop."

This station is used with standard magnetic starters, making it unnecessary to add time-delay attachments to the starters themselves. When power fails, the magnetic starter will, of course, drop out, but will be caused to reclose upon the return of voltage by the push-button device, unless the time for which the push-button station is set is exceeded, when the "Start" button must be pushed to energize the magnetic starter and so restart the motor.

In operation, pressing the "Start" button of the push-button station closes the pilot circuit of the magnetic starter and also the circuit of a coil in the push-button station. This coil is part of a "left" solenoid and, and when energized, causes the solenoid plunger to rise. At the bottom of the plunger as spring-attached contacts which are closed by the lifting action, thus maintaining the circuit through the solenoid itself and also the pilot circuit of the magnetic starter with which the device is used.

When voltage drops sufficiently to permit the solenoid to release the plunger, the latter starts to fall but is retarded in its downward movement by a rack which turns a gear. The gear engages a ratchet which can be adjusted for a maximum of 1½ seconds by means of a heavy nut at the end of the rod which serves as a pendulum. If power does not return before the time expires for which the device is set, then the contacts will be opened and both the solenoid and the magnetic starter will be disconnected until the "Start" button is again pushed.

Pressing the "Stop" button stops the motor immediately, because this action immediately opens the pilot circuit of the magnetic starter and likewise disengages the rock of the solenoid plunger so that the latter falls instantly.

New Single Suction Pumps

To meet the demand for a thoroughly well made and efficient centrifugal pump that can be purchased at a moderate price, the H. S. Cameron Steam Pump Works have developed a line of single suction open impeller pumps described in a recent bulletin.

These pumps are usually furnished for belting to steam engine, gas engine or some other form of prime mover. The casing is volute in form, made of the best close grained cast iron, and the interior is machined opposite the impeller, which is also carefully finished so that clearance is reduced to a minimum and the efficiency greatly improved. The suction opening is a central and the discharge can be placed to face horizontally, vertically or diagonally by swinging the casing on the supporting head.

The weight of the casing is supported by a cast iron head bolted centrally to the casing. This supporting head is provided with feet planed and drilled for fastening to bed plate. The stuffing box and inboard bearing are incorporated in this casing.

The standard impeller is of the open type, made of hard cast iron and carefully ground so that it fits the casing closely and is in perfect balance. The shaft is made of steel, key seated for impeller and pulley. A collar is fitted to the outer end for holding impeller central, and resisting any thrust action.

Rates for display advertisements in the Broadcast Section are given below. If you want to buy or sell used equipment, if you want a job or need a man, advertise your wants in Pit and Quarry. Advertisement copy for publication in the next issue should reach our office within one week after the date of this issue.

RATES PER INSERTION	1 Inch	2 Inches	3 Inches	4 Inches	5 Inches	6 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches	20 Inches	30 Inches
1 Insertion	$3.75	$7.25	$10.75	$14.25	$17.75	$21.25	$28.25	$31.75	$35.25	$42.25	$56.25	$70.25	$105.00
2 Insertions	3.75	7.25	10.70	14.20	17.65	21.15	28.15	31.65	35.15	42.15	56.15	70.00	104.00
3 Insertions	3.75	7.20	10.65	14.15	17.55	21.05	28.05	31.55	35.10	42.05	56.05	69.75	103.00
4 Insertions	3.70	7.15	10.60	14.10	17.45	20.95	27.95	31.45	35.00	41.95	55.90	68.75	101.00
8 Insertions	3.65	7.05	10.50	14.00	17.25	20.75	27.75	31.25	34.80	41.75	55.70	67.50	98.00
13 Insertions	3.60	6.95	10.40	13.90	17.05	20.55	27.55	31.05	34.60	41.55	55.55	66.25	94.00
26 Insertions	3.50	6.75	10.20	13.70	16.65	20.05	27.05	30.65	34.20	41.05	55.05	64.00	88.00

INFORMATION—*"Broadcast"* space is sold by the advertising "inch." Each page contains 30 inches. The width of the page is divided into 3 columns, each 2¼ inches wide. Each column contains 10 inches measured the length of the column. Any space may be used measured by the *even* inch in height (not fractions), by 1, 2 or 3 columns in width. The size of a space is its height in inches multiplied by the number of columns in width. Example: a space 3 inches high by 2 columns wide is 6 inches. Copy changes made without additional charge.

It Pays to Advertise in PIT and QUARRY

The Blue Mountain Stone Co., Hagerstown, Md., inserted an advertisement in the Broadcast Section of the July 20 and August 3 issues, and under date of August 12, 1927, they wrote that: *"We have had a number of responses to the advertisement recently run in your magazine. We are still getting additional inquiries, which is very satisfactory."*

Complete Service Publishing Company

538 South Clark Street **CHICAGO**

Rebuilt Guaranteed Equipment Priced Right

AIR COMPRESSORS

2—Steam driven Sullivan, 2-stage Compressors. One 1500 cu. ft.; one 950 cu. ft.
1—Sullivan 10x12 class W. G. 3, belt driven. Cap. 150 cu. ft.
11—Portable gasoline driven. Following makes: Chicago Pneumatic; Gardner, Ingersoll-Rand; Schramm; Sullivan; Zin-Ho; Domestic. Capacities from 30 to 210 C.F.M.

CABLEWAY EXCAVATOR

1—Sauerman 1 yd. Class G with teeth, complete with all fittings and sheaves, etc. for 400 ft. span and 16x16x60 ft. mast with fittings.

CABLEWAY BUCKETS

1—1½ yd. Dull slack line excavator bucket, with teeth (New).
1—1 yd. Dull slack line excavator bucket, with teeth.
1—Green 1 yd. Drag Scraper bucket.
1—Sauerman 1 yd. Crescent Drag Scraper Bucket.

CRANES and DRAGLINES

1—12-ton Orton gasoline crane, with 40 ft. boom and 1 yd. bucket, on traction wheels.
1—7-ton Orton steam, 30 ft. boom, on traction wheels.
1—15-ton 0 & S on 8 wheel MCB trucks, 40 ft. boom.

DRILLS

1—Keystone No. 3½ steam Well Drills with tools for 5½ inch blast hole.
1—Sanderson Cyclone No. 14 Jr. gasoline operated.
22—DCRW-23 Ingersoll-Rand, for 1-in. steel.
6—DCR-23 Ingersoll-Rand, for ⅞-in. steel.
3—DDR-13 Ingersoll-Rand.

SPECIALS

THOMAS DRAGSCRAPER HOIST

1—12x14, double drum, 2-speed, steel gears, levers banked in quadrant, front drum speed 200 ft. per minute, rear drum speed 600 ft. per minute. (Brand new.)

SHOVEL AND CRANE

Available immediate shipment, Atchison, Kan.
1—Type B Erie combination shovel and crane with high lift shovel boom, ¾-yd. dipper, 40-ft. crane boom, shop No. 2375.

DERRICKS

83—American Stiff Leg Derricks. Capacity 5 to 8 tons, with 14-in. square timbers, booms from 50 to 70 ft., with 12-ft. steel bull wheel.
32—American Stiff Leg Derricks. Capacity 8 to 12 tons, with 16 in. square masts, booms from 60 to 80 ft., with truss rods and 16-ft. steel bull wheel. Above derricks can be furnished for hook work or bucket operation.
2—Terry Steel Guy Derricks, 115-ft. mast, 100-ft. boom, 20-ft. bull wheel, capacity 15 tons with boom flat. One bucket operating.

SAND PUMPS

2—Morris, 8", direct connected to double 7x7 steam engine.
1—12"Morris belt driven.
1—Morris, 6" belt driven. Manganese fitted.
1—ERIE 6" belt driven.

LOCOMOTIVES

3—Porter, 18x24, 52-ton on drivers, with tenders, 6-wheel connected, practically new locomotives, with Walschaert valve gears, fuel oil burning, can be changed to coal burning for slight additional cost, used six months, equipped with air breaks, electric lights, wheel base 10 ft. 6 in., 48 in. dia. drivers, shop No. 6983-4-5-6, new 1925.
1—Davenport, standard gauge, 10x16, 20-ton Shop No. 1497.
2—Porter, 10x16, 18 ton, 36-in. gauge. Shop Nos. 4619, 4667.

HOISTS

60—American double drum Hoists, with attached swinging gear, capacity 6000 lbs., on a single line with 37 to 50-hp. A.C., 60-cy., 3-ph., 220 or 440v. motor, or with 35-hp., 220-v. direct current motor. Can also furnish with new 55-hp. Climax 4 cyl. gasoline engine or without power for belt and motor drive.
2—8x12, 3-drum Mundy, no boiler.
2—Lidgerwood 3-drum steam skeleton hoists, one size 10x10, one 9x10.
1—9x10 Clyde D. D. with boiler banked levers.
51—2-drum and single drum, size 12x12, 10x12, 9x10, 8½x10, 7x10, 6½x10, 5½x8, 4¾x6, all makes, also separate and attached swingers, holding drums for use with derricks.

SCREENS & SAND TANKS

1—48 in. x 108 in. Weller scalping screen.
1—30 inch Telsmith gravel screen.
1—Sackett 30"x9'0" with ⅝" perforations.

Write for Stock List No. 115—Listing a Million Dollars Worth of Equipment—For Sale or Rent.

Equipment Corporation of America

PHILADELPHIA, PA.
660 Horn Bldg. 1601 Chestnut St.

CHICAGO, ILL.
1460 Roanoke Bldg.

PITTSBURGH, PA.
860 Empire Bldg.

HOISTS

STEAM ELECTRIC AND GASOLINE

LOCOMOTIVE CRANE

1—5-ton Industrial, 4 wheel, 40-ft. boom, standard gauge, prime condition. Price, $1200, tracks, Bridgeport, Conn.

MALLORY MACHINERY CORPORATION **Baltimore, Md.**

FOR SALE

1—A-14 Ruggles-Coles Dryer, fully equipped with 100 H. P. 440 volts, 3 phase, A. C. Motor.
1—No. 6 Jumbo Williams Crusher, Shop No. 2089, fully equipped with 150 H.P. 3 phase, 60 cycles motor.
2—No. 5 McCully Gyratory Stone Crushers with A. C. Motors.
5—4-Roller Raymond Mills Complete with motors. Full details and very low reasonable prices quoted if interested.

CRESCENT PORTLAND CEMENT COMPANY
Wampum, Lawrence County, Pa.

reduce operating costs

In quarry operations, the outstanding economy of Porter Locomotive haulage has long been established.

For instance—a Porter can haul more tonnage in a single trip than any other form of transportation. It follows that the operating cost per ton of material hauled is lower.

Another point of importance—Porters last through many years of active service exceeding by far that of any other type of equipment.

This has been conclusively proved by the many long service records throughout the industry and the fact that there are more Porters in service than all other competitive locomotives combined.

See P&Q HAND BOOK Page 133

H. K. PORTER COMPANY
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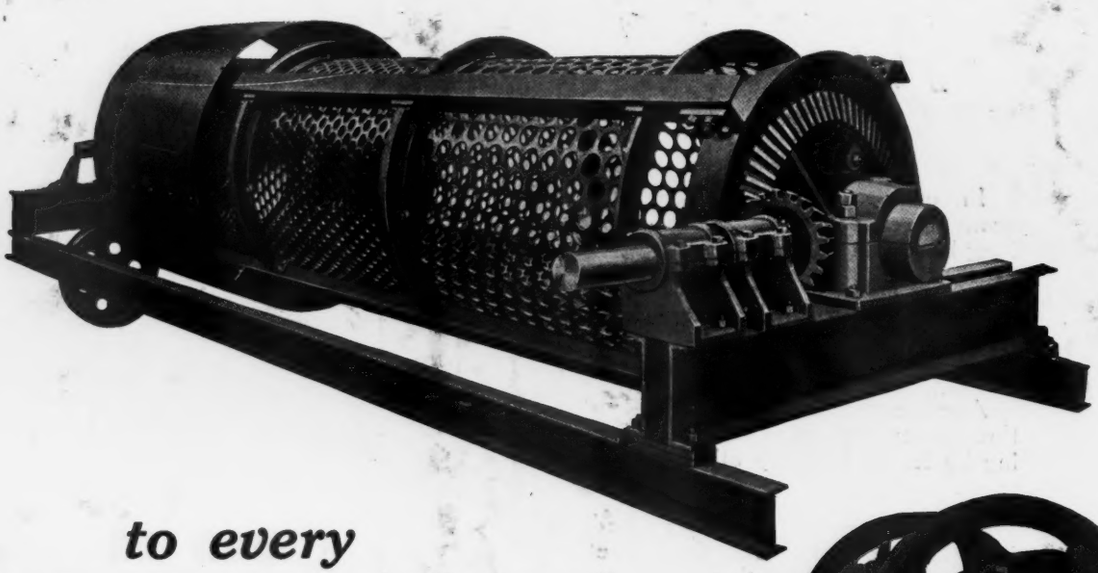
PORTER LOCOMOTIVES

H·K·PORTER CO. PITTSBURGH · PA.

ESTABLISHED PORTER "better built" locomotives 1865

THE MOST SATISFACTORY ANSWER



to every CRUSHING, GRINDING, SCREENING, WASHING, DRYING or ELEVATING Problem

The Progressive plant operator today must depend primarily on low costs to insure his profits. This means that when buying equipment he must demand reasonable first cost, low operating cost and low maintenance costs combined with proven dependable quality.

Lewistown Equipment meet the needs of the Modern plant from every angle. They are reasonably priced, well built, compact outfits—efficient and quickly installed.

Will you drop us a line, stating what equipment you desire information on?

9-Foot Dry Pan

Write for prices and give us your requirements

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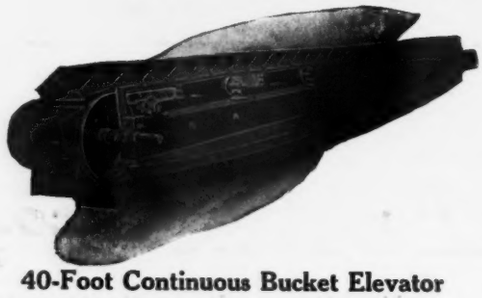

40-Foot Continuous Bucket Elevator

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